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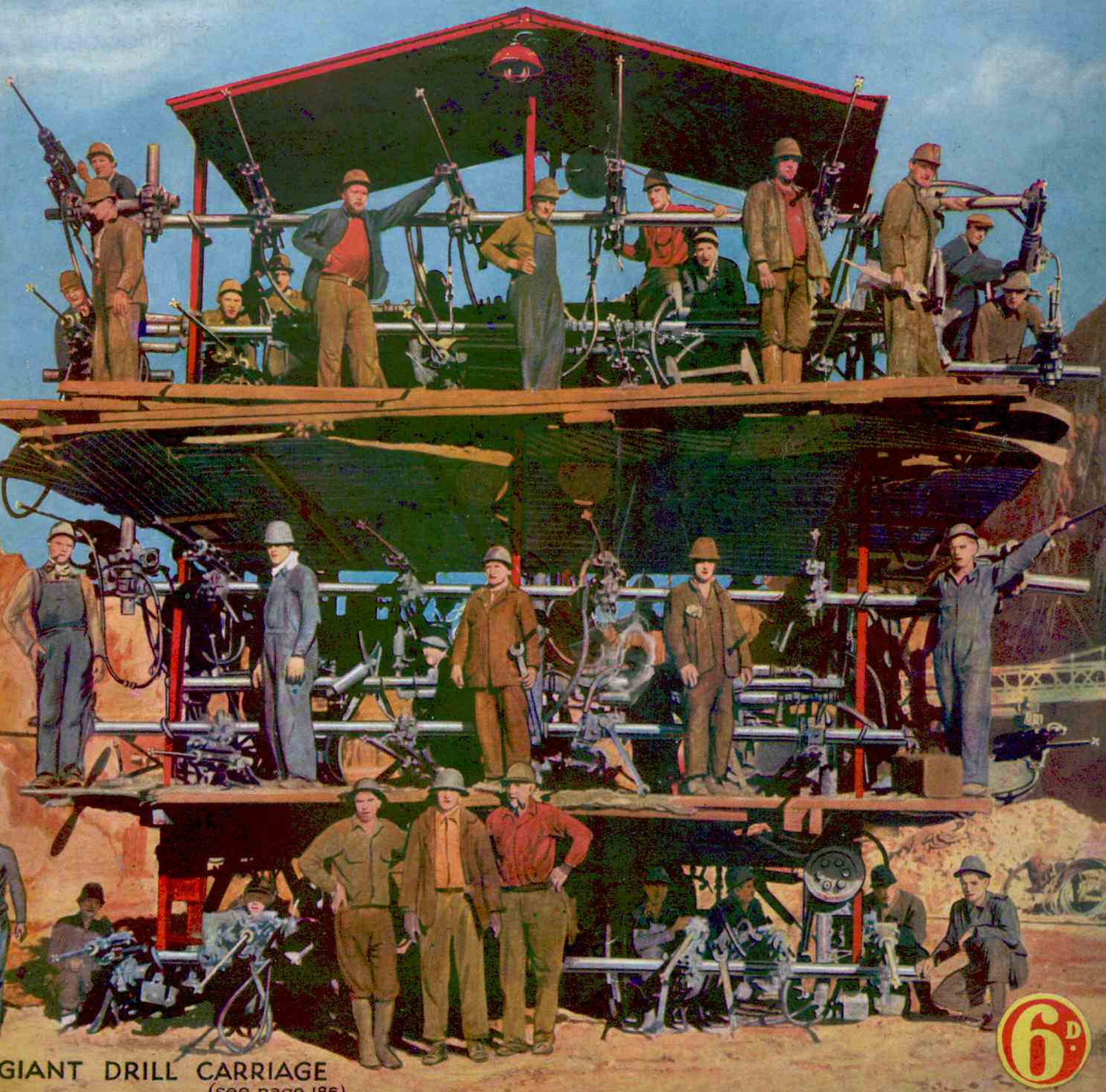

A GIANT DRILL CARRIAGE
(see page 186)

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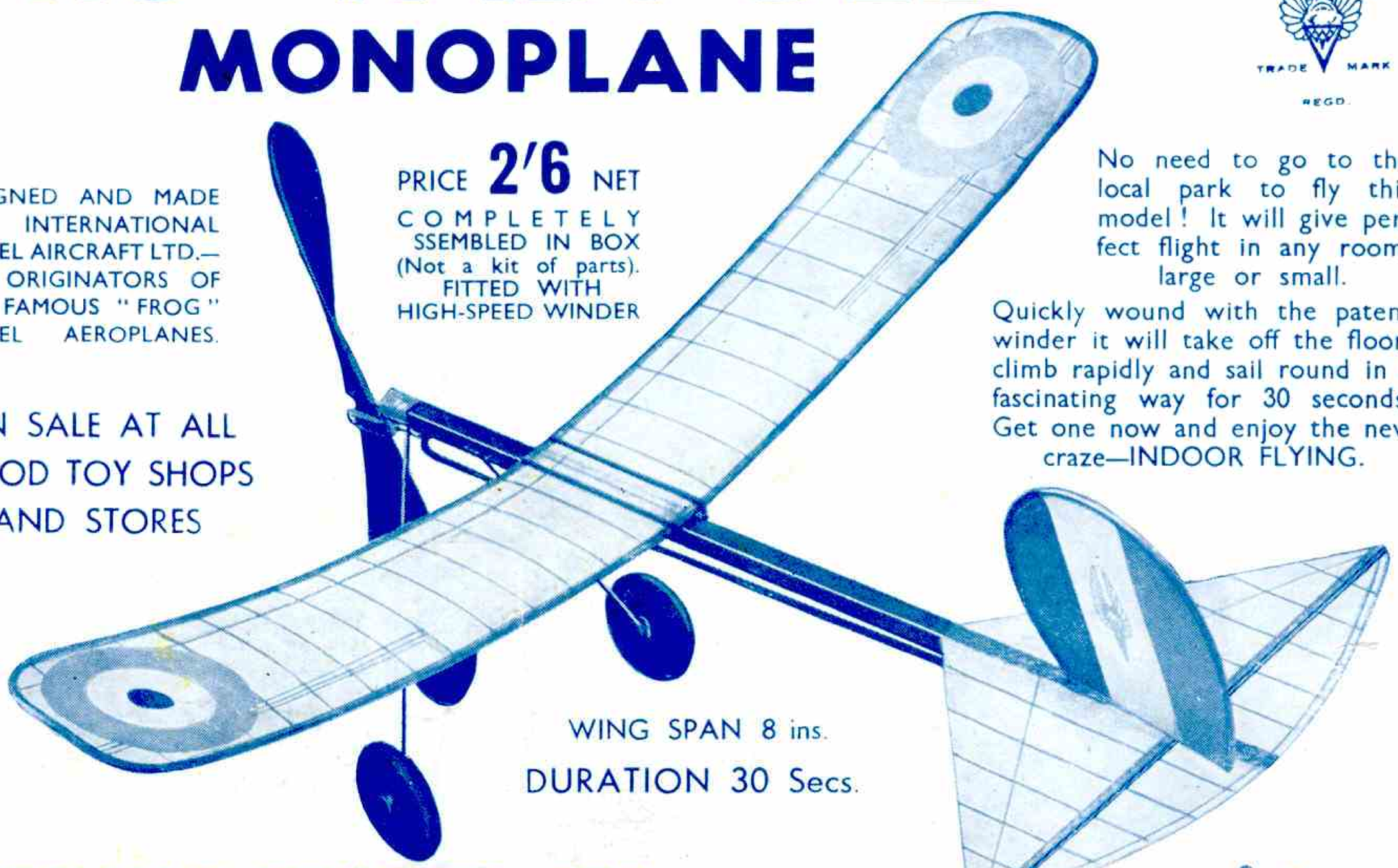

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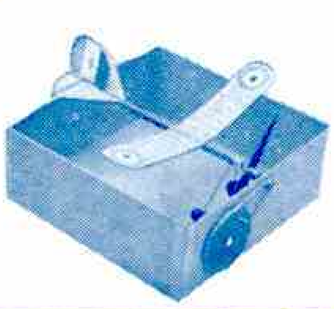

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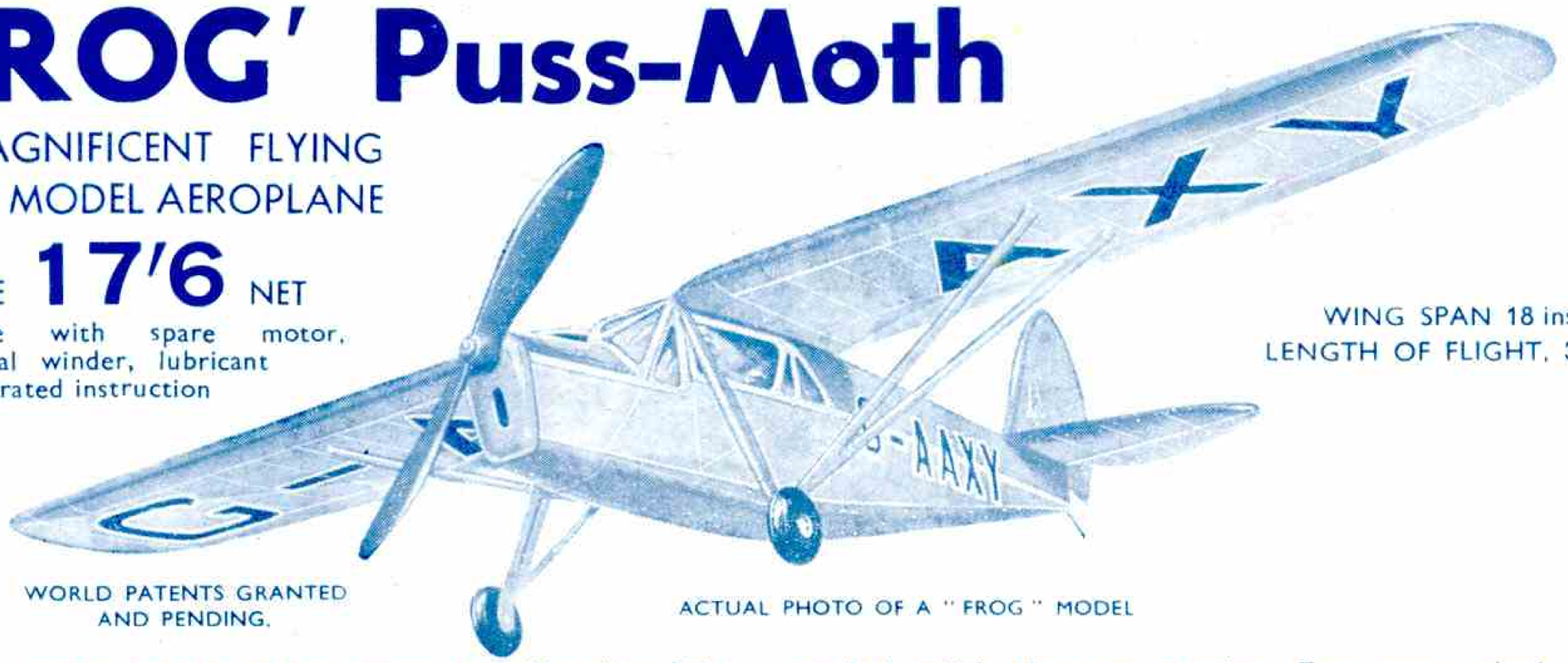

WING SPAN 18 ins.
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With the Editor

Wireless Service With 6½ in. Waves

I wonder how many of my readers have noted the fact that wireless has developed to its greatest extent during the years that have seen the conquest of the air. This has been fortunate, for wireless offers the only really effective means of maintaining communication between aeroplanes and the ground. Readers are already familiar with the use of wireless for this purpose from accounts that have been given in "Air News," and from special articles dealing with the various devices involved. Now comes another great development that will help in this all-important task. This is the introduction between Lympne and St. Inglevert, the famous airports on the British and French sides of the English Channel, of a wireless service employing waves only 17 cm., or about 6½ in., in length, and aerials with a length of 1 in.

An account of a trial demonstration of the method employed was given in "Our Busy Inventors" in our issue for September, 1931. This demonstration was so successful that the scheme has now been officially adopted by the British and French Air Ministries. The extremely short waves used, which are generated by a special type of valve known as a micro-radion, are called micro-rays. At the transmitters they are concentrated into a narrow beam by means of two parabolic aluminium mirrors; and at the receivers the beam falls on two similar mirrors that direct the waves on to the tiny aerial. The waves have extraordinary powers of penetration, and they give reliable signals of constant strength in all weathers and at all times of the day or night. Thus whenever a pilot circles round Lympne in the customary manner before setting off to fly across the Channel, his departure can be notified and St. Inglevert warned to keep a lookout for his arrival. This warning now can be given in a few seconds, whereas formerly 20 minutes were necessary, and aeroplanes flying at 100 m.p.h. actually could reach St. Inglevert before the message advising their departure from this side of the Channel was received.

A particularly interesting feature is that this wireless service can be carried on by means of Creed teleprinters. These ingenious machines have typewriter keyboards, and a message typed on the machine at Lympne is simultaneously and automatically printed on a paper roll running on the machine at St. Inglevert. Thus the operators send and receive messages direct, and at the same time record a printed copy of the exchanges. This has previously been impossible in wireless work owing to the difficulty of ensuring communication of constant strength free from interference and atmospherics.

Now that waves as short as these can be generated we may look for further wonderful developments. For instance, the micro-rays may offer a solution to the problem of overcrowding that is so troublesome in commercial wireless as well as in broadcasting, for there is room for nearly a quarter-of-a-million transmissions of slightly different wavelength that will not interfere with each other. For this reason the waves may prove particularly useful for television, the commercial development of which has been hampered so far by the fact that it needs a wider wave band than can readily be obtained with waves of the length used for broadcasting.

Last year Marchese Marconi achieved transmission over 170 miles with these very short waves. He suggests that their range might be greatly extended by means of successive relays, and that they would then provide a reliable system of communication between different parts of the Empire.

The large reflectors used for transmitting micro-rays, or very short wireless waves, from the aerodrome at Lympne to that at St. Inglevert, France. These reflectors are mounted on the roof of one of the hangars, and the aerials used in conjunction with them are only an inch in length.

The Nation's Water Supplies

The long spell of dry weather that we experienced last year caused a serious fall in the level of reservoirs in all parts of the country. It was naturally expected that the winter rain would make good the deficiency, but unfortunately this rain has not arrived to anything like the extent anticipated. In addition, it is considered by many experts that we are now entering on a period in which the rainfall will continue to be below the average. If this proves to be the case there may be a serious shortage of water in many parts of the country, and this possibility lends interest to a scheme proposed by Mr. A. E. C. Chorlton, M.P., who is President of the Institution of Mechanical Engineers.

Mr. Chorlton's proposal is that three immense lakes to form water reserves should be created by the Government, and he suggests that these should be in the Thames Valley, on the border of South Lincolnshire, and in the Lake District respectively. The construction of these great reservoirs would be accompanied by the laying of an elaborate system of long pipelines to enable the total water resources to be pooled in a similar manner to the pooling of electrical power by means of the recently-completed "Grid." Thus a water shortage in any particular district could be quickly relieved by supplies from the main reserve.

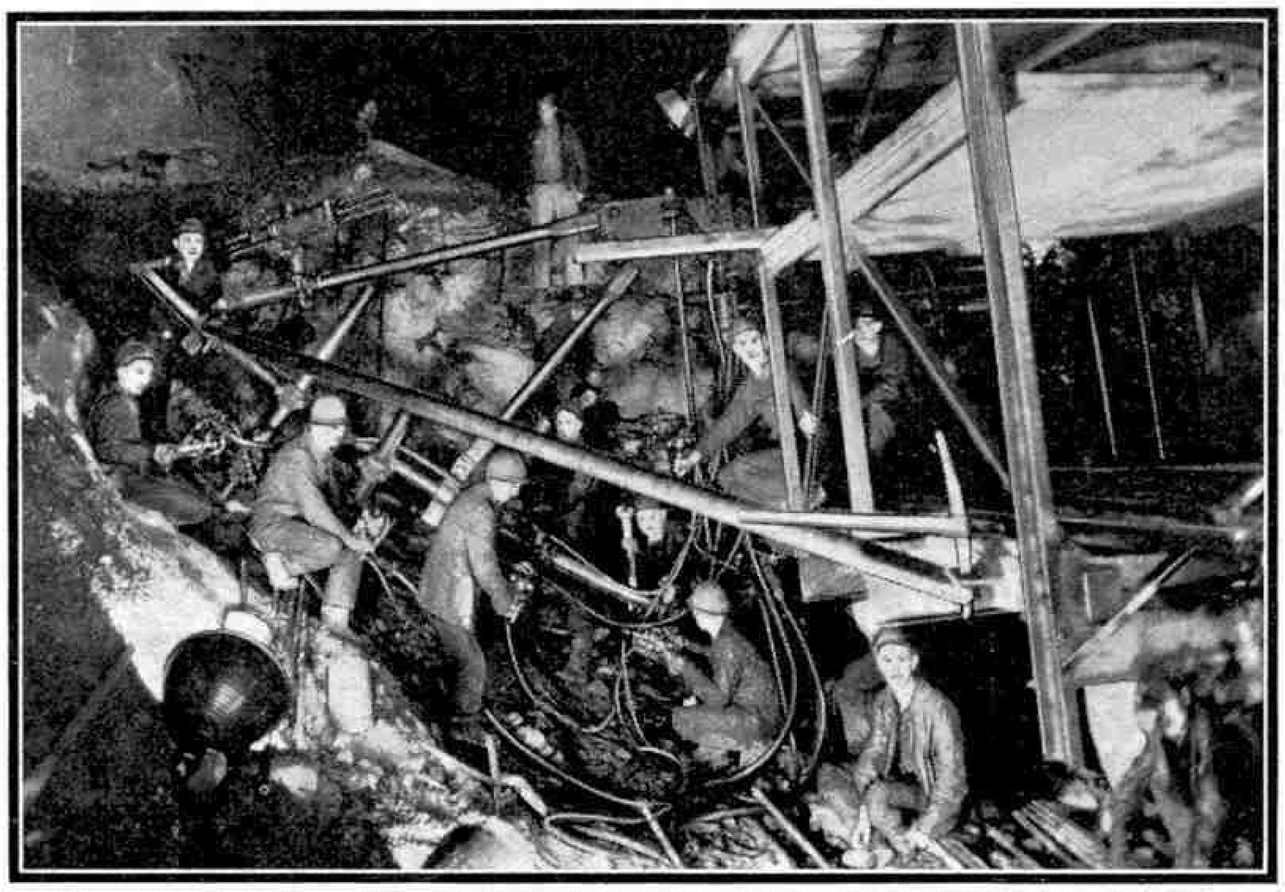
In view of the experiences of last year, a scheme of this kind seems worth careful consideration. It is true that none of the big towns suffered anything like a serious water shortage, but in many villages the normal supply failed completely, and water had to be brought long distances in water carts or even buckets. The constructional work involved in such a scheme would of course cost a great deal of money, but it would be a sound national investment, and also would provide work for thousands of men for many years. In addition the scheme would help in making preparations to meet the increased demand for water that will accompany the growth of our large cities.

The Story of Hoover Dam

II.—Boring the World's Largest Rock Tunnels

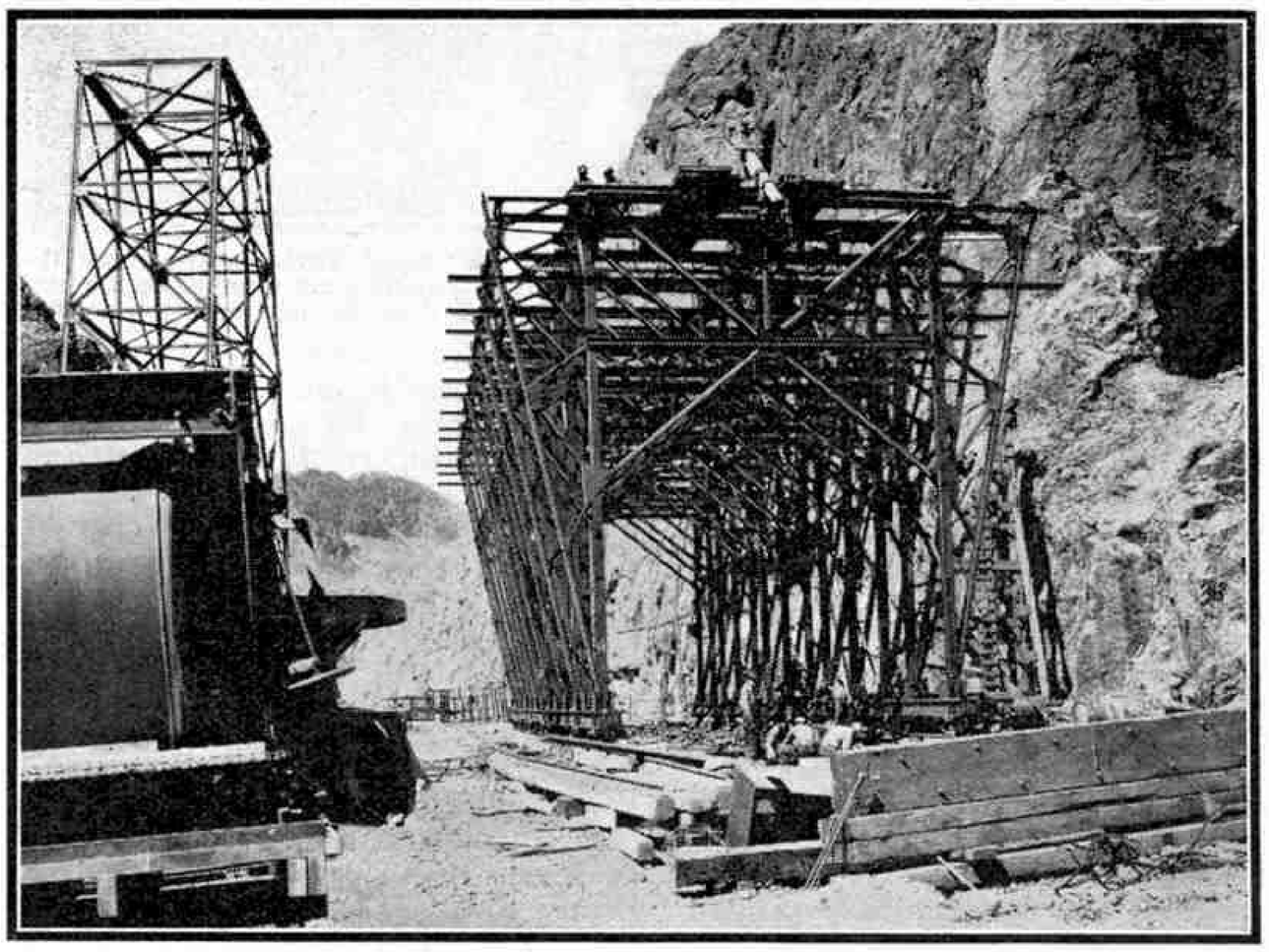
LAST month we explained why it became necessary to tame the Colorado River, which for years repeatedly threatened, when in flood, to overwhelm the prosperous cities and the fruitful farms of Imperial Valley, at the head of the Gulf of California. For this purpose a gigantic mass of concrete known as the Hoover Dam is being erected in Black Canyon, a tremendous gorge with precipitous sides from 800 ft. to 1,000 ft. in height; and the water that eventually will accumulate behind the dam will be used for irrigating great areas of fertile soil and also for generating electric power.

The dam will rest on a rock foundation 150 ft. below low-water level of the Colorado River, and before it could be built it was necessary to divert the stream into four immense tunnels, driven through the rocky walls of Black Canyon, to carry it round the site chosen for the structure. There are two of these tunnels on each side of the river. They are circular in cross section and 56 ft. in diameter; their combined length is nearly three miles, and 1,500,000 cu. yds. of rock were removed in constructing them. No rock tunnelling project of this magnitude has ever previously been attempted, but in spite of the immensity of the task, the four tubes were excavated in little over a year, an army of from 1,200 to 1,500 men working day and night in 8-hour shifts.



A crew at work drilling the invert, or bottom section, of one of the tunnels through which the Colorado River has been diverted. We are indebted to the "Compressed Air Magazine" and Six Companies Inc, for the illustrations to this article.

Tunnel driving in the walls of Black Canyon began even before a roadway had been constructed into the depths of the great chasm. The nearest point at which access to the river level could then be obtained was two miles above the site of the dam, and there barges were built and loaded with Ingersoll-Rand portable air compressors and drilling tools. The barges were lowered downstream by means of cables, and moored near a small slope formed by the falling of rocks from the cliffs above. This slope was near the centre of the future dam, and was the only accessible place on the Arizona side of the Canyon. A similar precarious foothold was then gained on the opposite side of the river by building a cable suspension footbridge across it and blasting out a small shelf on the cliff. The compressors and drills were landed on these working places, and adit tunnels measuring 10 ft. by 8 ft. were driven at right angles into the cliffs in order to intersect the lines of the four diversion tunnels.



Building the "Jumbo" or travelling frame, employed in concreting the arch of one of the diversion tunnels. The concrete was shot into position by means of a compressed air gun.

When the adit tunnels had been driven far enough, the task of boring right and left towards the portals of the main tunnels themselves was begun. This work was to be carried out in sections, the first step being to drive a top heading measuring 12 ft. square, the purpose of which was to provide ventilation and to give easy access for the task of widening the narrow openings out to the full diameter of 56 ft. The adits gave access to two working faces in each tunnel. In the meantime part of the rock debris excavated was used in building roads at the foot of the cliffs to enable the positions of the ends of the tunnels to be reached, and drilling operations were then begun from each portal. Thus boring operations were carried on at four different points in each tunnel, making a total of 16 working faces.

The task of enlarging the tunnels began at several faces before the driving of the top headings had been completed. For work on such a big scale, new means of mounting the large number of drills to be used had to be devised, and after due consideration these were placed on gigantic steel frames provided with platforms to enable work to be carried on simultaneously at different heights. Each frame was mounted on a motor lorry chassis with a long wheelbase, and was of such a size that it could be used to drill a section 30 ft. in depth below the top heading, and extending over half the width of the tunnel.

The giant drill carriages were christened "Jumbos" in tribute to their immense weight and strength. Each carried 30 drills, mounted in five lines, four of which were operated from its two platforms, while the lowest was operated from the ground. When in operation a Jumbo was backed up against one half of the hard rock it was to remove and securely jacked in position. The necessary connections for electric light, compressed air to drive the drills, and water to flow over them as they penetrated into the rock, were made, and within 20 minutes the ponderous machine was ready for actual drilling. This proceeded rapidly, the average drilling time for each bench heading being four hours, during which the steel drills penetrated to an average depth of 16 ft.

When half of a 30-ft. section had been drilled in this manner, the Jumbo was moved forward and backed into position to drill the remaining half. Meanwhile the holes that had been already bored were loaded with dynamite, more than three-quarters of a ton of which was required for each working round. It was hauled by trucks into the tunnels as it was needed, and the necessary primers, or detonators, were

prepared by men working in isolated houses and were then carried into the tunnels in specially-designed containers.

On the completion of drilling operations the Jumbo was moved back from the face and the remaining holes were loaded. The dynamite was then detonated electrically, the 94 charges inserted being exploded in 16 groups, fired at very short intervals. The rock broke cleanly, and the debris was removed by means of 100-ton electric shovels equipped with buckets of 3½ cu. yds. capacity.

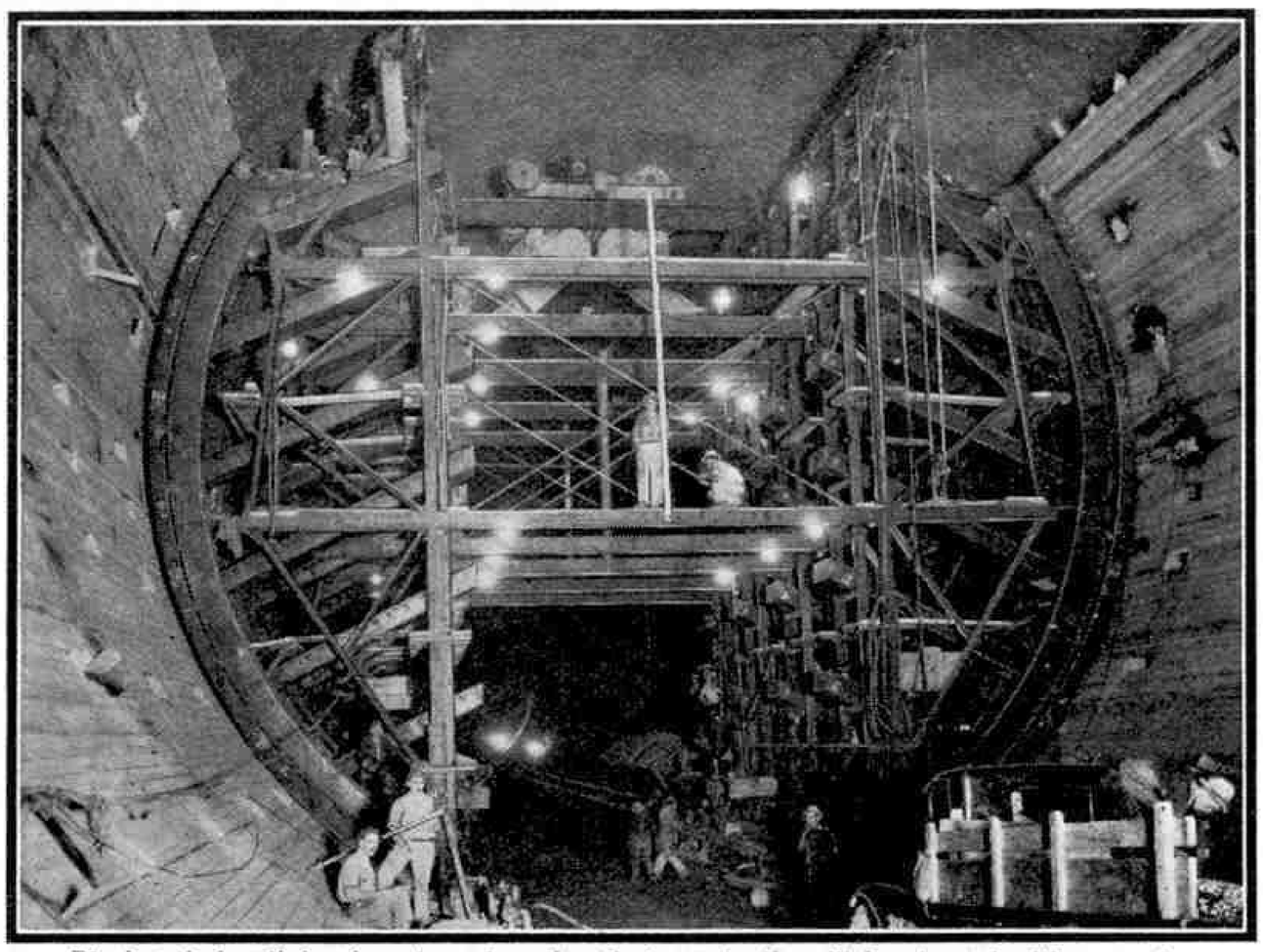
After the blasting the smoke and gases produced during the explosion collected in the roof of the tunnel, and were quickly dispersed by means of blowers that discharged air into the tunnels through pipes 18 in. in diameter at the rate of 8,000 cu. ft. per minute. Work could be resumed five minutes after firing the charges, and the ventilation arrangements were so effective that the men who removed the debris always worked in cool, clean and pleasant conditions.

When this part of the work was finished the lowest sections of the tunnels still had to be drilled out in order to give the great tubes the circular outline designed for them. For this purpose the tops of the Jumbos were removed, and folding wings were erected on each side to support curved boards on which drills could be mounted. These drills were so distributed that in operation they bored their way downward into the rock of the inverts, or curved sections at the bottoms of the tunnels, and subsequent blasting broke up the material in readiness for removal.

The walls then required trimming and scaling, and this operation actually was begun while the invert section was being drilled. The special Jumbo designed for this purpose was horseshoe shaped and ran on rails laid through the tunnel. It had an outside diameter of 50 ft., thus bringing it within a few feet of the walls themselves; and rocky projections on the walls were removed by means of drills erected at different elevations on its framework.

Before water could be admitted to the tunnels it was necessary to line their sides with concrete, and preparations for this were made while boring operations were in progress. A large amount of concrete was required, for the linings are 3 ft. in thickness, and it has been calculated that the volume used would have paved 135 miles of a road 18 ft. wide to a depth of 10 in. Even this enormous quantity is small compared with that required for the giant dam itself, for this will consist of more than three million cu. yds. of concrete; and the quantity of material in the structure will be sufficient to build a roadway of the same width and thickness as that just mentioned, but with a length of no less than 1,070 miles.

For the preparation of concrete on this enormous scale, a giant mixing plant and an immense store of concrete, sand and gravel were necessary. The cement reached the site of the dam by rail, finishing its journey on one of the many tracks laid down by the contractors. The remaining materials were obtained from gravel deposits 30 ft. in depth about six miles from the site of the dam. It is interesting to realise that these deposits were laid down by the River Colorado. The river indeed is helping to control itself, for not only did it bring down a great part of the material that will find its way into the dam, but also it cut its way through the rocks to form the gigantic canyon that provides an ideal site for the great mass of concrete by means of which it will be harnessed.

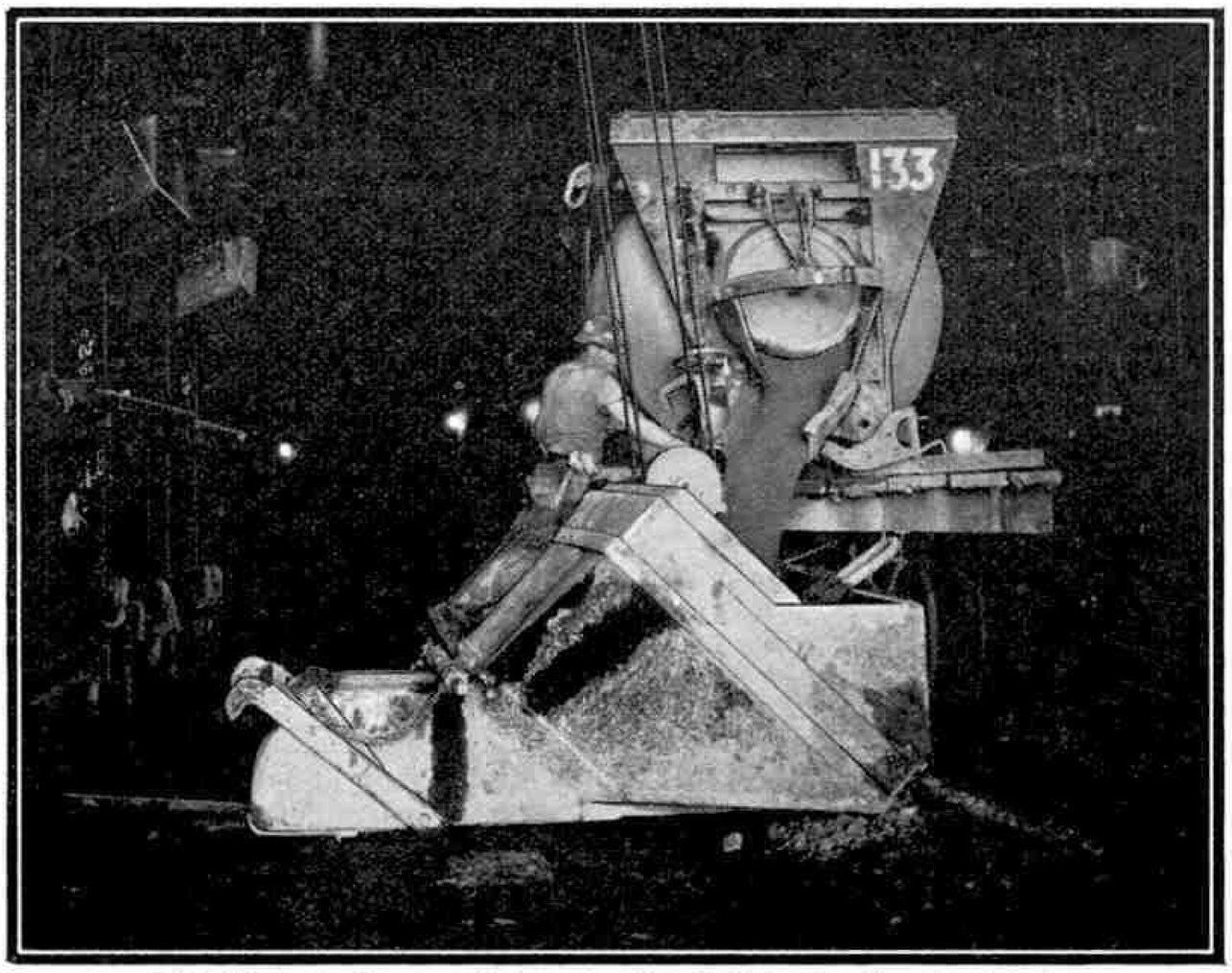


Placing timber lining in a tunnel section that eventually will be plugged with concrete.

In order to prepare the sand and gravel for the concrete mixer, the largest screening and washing plant ever built was constructed on flat ground about two miles from the river. The framework of this plant contained 350 tons of structural steel, and the total cost of erecting it was nearly £100,000. All the materials were thoroughly washed by means of water derived from the river, and the screens separated the gravel into three different grades.

The concrete mixer itself was built on an equally gigantic scale. It was impossible to place it near the site of the dam because of the steepness of the cliffs, and instead it was built about 4,000 ft. upstream on the Nevada side of the river, its position becoming known as "Lomix." Eventually it will be removed from "Lomix" to "Himix," a place already chosen on the brink of the cliffs above the dam, in order to enable the upper part of the structure to be completed without having to raise concrete to great heights.

The mixing plant is 117 ft. in height and of proportionate width. It is built of 800 tons of steel, and has timber sides and partitions. The cement and other materials required reach the site by rail and then travel along the moving belts of an enormous inclined conveyor that carries them into storage bins at the top of the mixer. From the bins they pass into hoppers through gates that are automatically closed when the required weight of each material has passed through; and finally they fall into mixers in which they are churned with water drawn from the River Colorado.



Filling buckets with concrete in preparation for lining the diversion tunnels.

Each mixer produces 4 cu. yds. of concrete in 3½ min. The operation throughout is continuous, the cement, sand and gravel flowing into the top of the plant in a stream, and the concrete being poured into trucks under the mixers as soon as it is ready. At first four mixers were installed, but the plant is being extended and eventually will be capable of turning out a cubic yard of concrete every nine seconds.

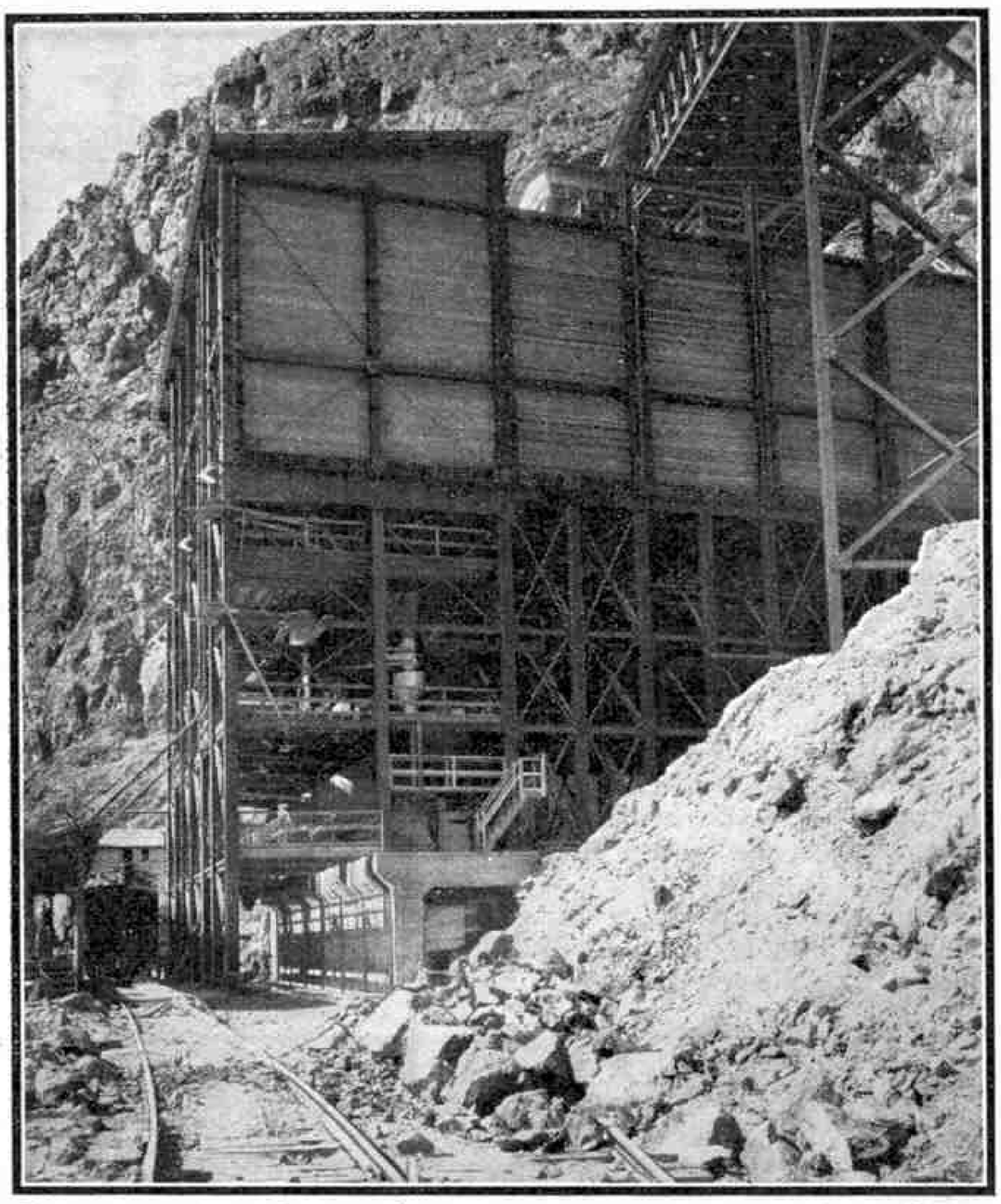
The concrete for lining the tunnels was carried to the portals in drums. Concrete cofferdams, supported on their river faces by rock fills, had been erected in order to prevent water from flowing into the tunnels when the level of the river rose. These obstructions prevented the passage of the trucks carrying the drums, and the concrete therefore was poured through chutes on the tops of the cofferdams into steel buckets on their inner sides. The buckets were carried into the tunnels on 10-ton trucks, and on arrival at the working place were lifted into position for pouring by means of cranes.

The concrete linings of the four tunnels were built up in three sections. The first was the lowest, or invert section; the next

consisted of the side walls; and the last section to be poured was the lining of the roof. As was the case for practically every operation necessary for the building of the dam, special means were necessary in order to ensure the concrete being poured quickly and accurately; and the concreting Jumbos designed for this purpose were of such lengths that sections 40 ft. and, in some instances, 80 ft. in length were lined in each round of pouring.

The first step in lining the invert section was to concrete two strips running along the length of the tunnel, on which to place the rails for an electric gantry crane. Forms into which the concrete was to be poured were then placed in position and filled by means of the gantry crane, which hoisted the buckets of concrete and tilted them so that their contents fell into the desired place. The concrete was puddled in by workmen, and its surface smoothed off and shaped by sliding metal plates. As each section was filled the framework was jacked up and moved on to the next. Finally sand was laid down in order to form a level roadway to enable lorries and trucks to run into the tunnel with concrete for the remaining sections.

The Jumbo built for lining the side walls was a mammoth structure 80 ft. in length and 50 ft. in height, and weighed no less than 385 tons. It supported the steel plates that were placed parallel to the walls of the tunnels in order to enclose the space to be filled with concrete. It ran on tracks placed 23 ft. apart on special runways of concrete, and was made in five sections in order to enable it to "snake" its way round the curves in the tunnels. It carried a 50-ton electric crane that hoisted the buckets containing concrete to enable their contents to be discharged down chutes leading to the space between its plates and the tunnel walls. Several rows of chutes were provided on each side. Pouring commenced with those at the lowest levels, and these were closed by means of steel doors, or gates, when the level of the concrete reached them. Concrete was then fed in through higher chutes until the entire side wall section had been lined. When the concrete had set, the Jumbo was moved to the next section, where the operation was repeated.



The gigantic mixing plant that is preparing the concrete required for the Hoover Dam. The cement, gravel and other materials required are automatically weighed before passing into the mixers in order to ensure a uniform product.

The actual pouring of each section of the side walls occupied about 24 hrs., and the forms were left in position 10 hours longer. Altogether about 50 hours were required to line a side wall section 80 ft. in length, and to remove the Jumbo in preparation for beginning the next section.

Concreting the top section of the arch of the tunnels introduced a new problem, for it was impossible to pour the material upward into position. It was therefore shot by means of compressed air guns into the space left between the arch and the steel forms of the Jumbo designed for this task. Two guns were mounted on the carriage, and each was loaded repeatedly with two cu. yds. of concrete that was shot upward and forward through an 8-in. delivery pipe into the space it was to occupy.

The tunnels were concreted throughout with the exception of sections 396 ft. in length in two of them, which were lined with timber. Ultimately these sections will be plugged with concrete in order to enable parts of the tunnels to be employed for power purposes.

The tunnels on the Arizona side of the river were ready to receive the waters of the Colorado on the 13th and 14th of November, 1932, and on those days large blasts of dynamite demolished the cofferdams that had been built at their portals. Water flowed through the channels thus created, and part of the river immediately started on its new underground course instead of flowing southward between the walls of Black Canyon. A dam to divert the stream from its old bed was then built just below the tunnel intakes by dumping rock into the river. This work was completed in 30 hours, a stream of motor lorries depositing four loads a minute in the water until the dam was high enough to turn the entire flow of the river into the two tunnels. A similar dam was constructed above the outlets of the giant tubes in order to prevent water pouring out of them from backing up towards the site of the dam.

The two dams thus built were only temporary, for far more elaborate structures were necessary to ensure that even in its stormiest mood the river should not disturb the erection of the Hoover Dam itself. The building of gigantic cofferdams for this purpose therefore was the next undertaking. Preliminary work in connection with the upper cofferdam had indeed already commenced, for a railway had been built along the Nevada side of the Canyon along which the necessary earth and gravel could be brought from pits three miles upstream, and part of the site had been uncovered by dumping material into the bed of the stream to crowd the water over to the Arizona side. The diversion of the water through the gigantic tunnels laid the whole site bare, and this was excavated to a depth of 18 ft. below the river bed in order to provide a firm foundation.

Although the construction of the cofferdams was only part of the preliminary operations leading to the erection of the Hoover Dam, it was a gigantic undertaking involving heavy responsibility. This was particularly true of the upper cofferdam, for failure to restrain the Colorado when in full flood would result in indescribable confusion and devastation. For this reason the responsibility for its design was assumed by the Government. Its construction was begun by dumping earth and gravel at the end of the railway already referred to. This material was reloaded into motor lorries by means of gigantic shovels, and carried to required points on the side of the dam, where six-ton rollers drawn by 30 h.p. tractors compressed it into a hard resistant mass. The work went on night and day, the shovels employed in the operations lifting and dumping their loads of earth and gravel every 30 seconds, and on occasions as many as 4,000 loads of earth, amounting to 18,000 cu. yds. were placed in position in 24 hours.

In this manner a gigantic mound of earth and gravel 568,000 cu. yds. in bulk was laid across the normal course of the river. Protection from the attack of the Colorado when in flood was provided by covering its slopes to a depth of 3 ft. with lumps of rock, consolidated by sluicing silt and clay into the crevices, and driving steel sheet piles into the river bed on the upstream side. Finally both faces of the dam were covered with reinforced concrete 6 in. in thickness.

The finished structure measures 480 ft. from one side of the Canyon to the other, and is 70 ft. in width at the crest, and 750 ft. at its base. It rises to a height of 98 ft., and it is believed that its crest will be 13 ft. above the highest flood level.

The lower cofferdam does not carry so much responsibility as the one erected upstream from the site of the Hoover Dam, and is smaller. Both structures will remain in place until the Hoover Dam itself has risen to such a height that further protection is unnecessary. Eventually the upper cofferdam will be submerged in the gigantic lake that is to be formed, but the one erected lower downstream will be removed, for the river channel there must be thoroughly cleared in order to allow free play for the water flowing away from the turbines of the gigantic power plants that are to be a great feature of the dam.

When the site of the dam had been completely enclosed by the erection of these great mounds, the water remaining on it was removed by means of a tunnel driven under the rocky bed of the river and rising into the enclosed area. Excavation was then commenced in order to provide a solid foundation for the immense mass of concrete that is to form the dam, and the walls of the Canyon were smoothed off at the points where they are to act as buttresses to the ends of the structure. This brought to an end preliminary work that had occupied more than two years and the erection of the Hoover Dam itself then became the chief task of the engineers. A future article in this series will explain how this work was carried on.

Modern Methods of Fighting Friction

An Ingenious Mechanical Lubricator

PROPER lubrication of rubbing surfaces in engines and machines is a matter of vital importance to their efficient running.

Bearings or other parts of a mechanism in which there is a high degree of friction not only absorb valuable power but need to be renewed frequently, so that maintenance costs are considerably increased.

In the early days of engineering, engines and machines were much slower running than they are to-day, and manual methods of lubricating were considered sufficient ; but with the development of high-speed engines it became evident that more efficient lubricating methods must be adopted. As a result mechanical lubricators operated by the machines themselves were devised, and some of these are very interesting in their construction and operation. An ingenious device is the automatic lubricator sold by Hunt and Mitton Ltd., Birmingham, as the "F" type, which is designed specially so that it can be adapted to almost any kind of machine or different types of drives. The lubricator works on the pump principle and is made in several different types, but in each case it is built up from a number of separate units or sections.

The accompanying drawings show the F type Mechanical Lubricator in its most simple form, that is as a single-feed lubricator. By the addition of further pump sections or units, a lubricator suitable for a larger number of separate feeds can be built up.

As will be seen, the lubricator is built up by fitting together a number of circular cast iron sections, or cells, comprising a separate pump section for each feed ; driving section, either rotary or reciprocating ; two or more fixing bracket sections ; oil level gauge section ; an end section containing filler and strainer, and where the cross drive is used, a plain end section.

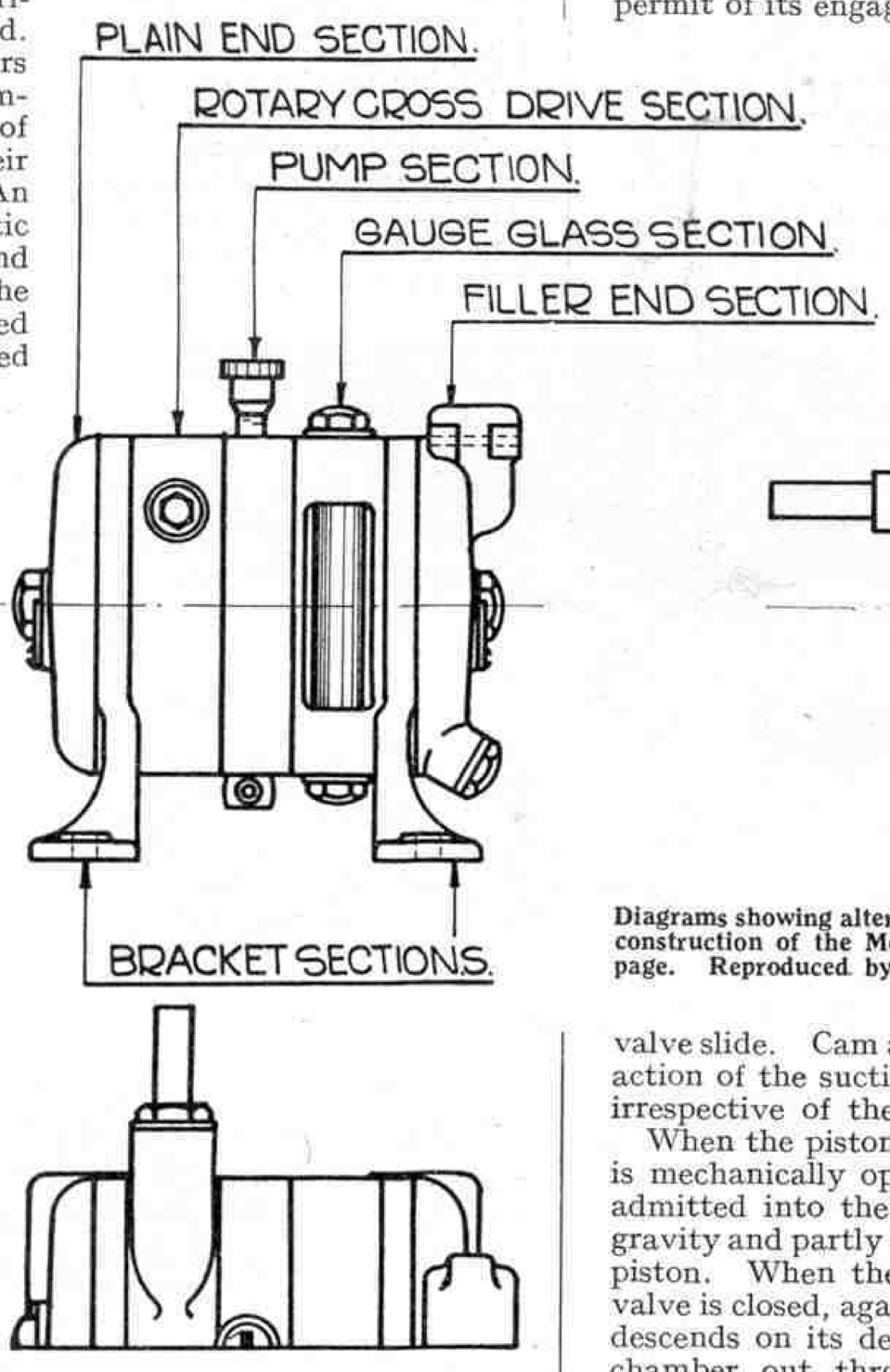
The various sections are spigotted and socketted and fit one into the other, the whole being rigidly clamped together by means of a special steel bolt that passes through the centre of the lubricator and is secured at each end by a hexagon blank nut, locked so it cannot work loose. The sections so butted together form an oil chamber and the pump units work in an oil bath, an arrangement that greatly reduces wear and tear. A separate pump section is required for each feed, and any number of pump sections up to 16 or more can be included in one lubricator.

The drive to the lubricator is taken from the machine or engine to which it is fitted, and may be rotary or reciprocating and arranged at one end of the lubricator or at the back. A hand flushing handle is generally provided, although this feature is not essential to the construction.

This multiple cell form of construction gives compactness and lightness, thus making the lubricator particularly suitable for use on machines where weight and space are of vital importance. Every part is standardised and interchangeable, and every detail is carefully thought out in the user's interest.

Each separate feed has its own independent pump complete with driving cam and contained in a cast iron circular section 100 mm. outside diameter and 20 mm. wide. The moving parts are held and guided by a rectangular machined sleeve supported by three arms cast on the inner periphery of the section. Up and down this sleeve move two slides guided by two grooves cast in the walls of the sleeve. One of the slides operates the suction valve, and the other the pump piston. The suction valve is greater in diameter than the piston, and its centre forms the walls of the chamber through which the piston moves.

Passing through the slides is a hollow camshaft, through which passes the central spindle or bolt by means of which the sections are clamped together. This camshaft is toothed at both ends to permit of its engaging with the similar shaft of neighbouring feeds when more than one pump section is used. When a series of pump units are assembled these cams are as one shaft, and can be rotated all together by a common driving gear unit situated at either end of the lubricator, or in the centre, whichever position is best suited to a particular case.



Diagrams showing alternative drive arrangements and the unit construction of the Mechanical Lubricator described on this page. Reproduced by courtesy of Hunt and Mitton Ltd., Birmingham.

Only one cam is machined solid with the shaft, and this moves the slide operating the pump piston. Fitted on the shaft immediately adjoining this cam is an eccentric that operates the suction valve slide. Cam and eccentric are so shaped and arranged that the action of the suction valve and piston are perfectly synchronised, irrespective of the direction in which the lubricator is rotating.

When the piston is at the bottom of its stroke the suction valve is mechanically opened, the piston commences to rise, and oil is admitted into the oil delivery chamber, partly by the action of gravity and partly by being drawn in by the suction of the retreating piston. When the piston is at the top of its stroke the suction valve is closed, again mechanically, and held closed while the piston descends on its delivery stroke and forces the oil in the delivery chamber out through a small spring-operated valve into the feed pipe, and so in time to its destination.

The movements of both piston and suction valve are mechanically, and therefore positively, controlled throughout. This is one of the most important features of the lubricator, for it ensures that the valves cannot fail through being gummed up in cold weather with thick oil, or because some grit has settled on the valve seating.

The driving sections, being entirely self-contained, can be revolved round the axis of the lubricator, which is formed by the central securing bolt, and locked in any position most convenient.

The lubricator is fixed to a machine by means of fixing bracket sections. These are plain sections of cast iron having a bracket cast on one side with lugs and two drilled holes for the fixing bolts. The bracket sections also can be revolved round the axis of the lubricator and locked in any position.

The purpose of the oil level gauge section is obvious. The end section containing filler and strainer forms one end of the lubricator, and has a hinged lid through which the oil chamber can be filled. A fine mesh wire gauze strainer is also included, and a hexagon-headed drain plug is provided on the underside. Plain end sections are only required when the cross drive is used. They finish off the lubricator by completing the end opposite the filling section.

WHEN the Spaniards who followed the track of Christopher Columbus extended his explorations by penetrating into the inner regions of the American continent itself, they discovered great native empires in Mexico and Peru. These are not the only ancient civilisations that have flourished in America, however, for in other parts of the continent there were thriving communities centuries before it became known to Europeans. Among these communities was a race of Indians living in the Southwest of what is now the United States. The ruins of their dwellings are found in Arizona and New Mexico, and also across the borders that separate these States from Colorado and Utah. Their villages were unique, none like them having been discovered in any other part of the world; and the tools and utensils discovered in them reveal their ancient inhabitants as highly-cultured tribes of the late Stone Age in North America.

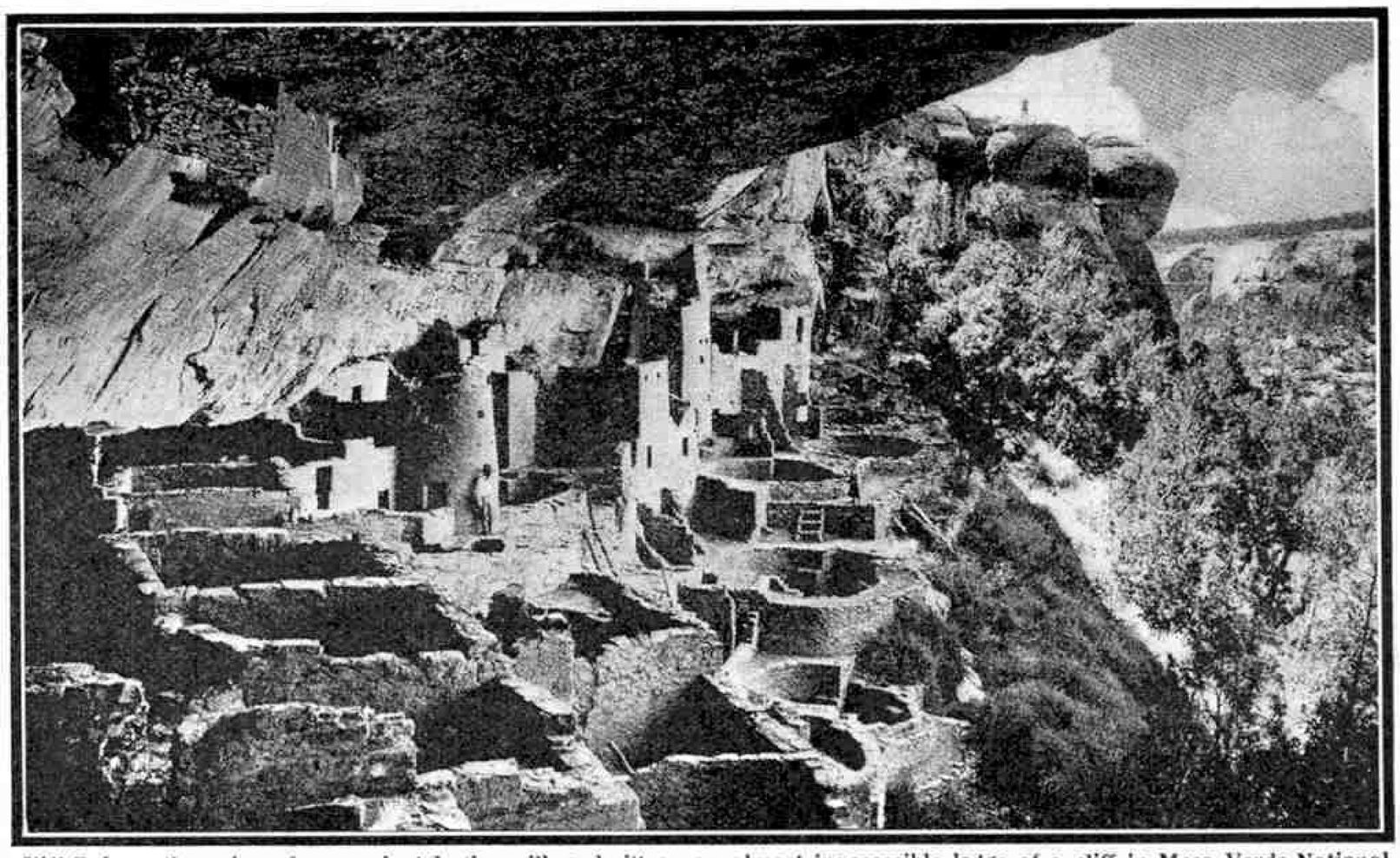
The most famous of the ruins in the Southwest of the United States is Pueblo Bonito, or "Beautiful Village," in Chaco Canyon, New Mexico. This is best described as a communal house built of stone, for in its prime it was a single gigantic building that is believed to have been the home of about 1,200 persons. It covered an area of three acres, the number of rooms on the ground floor alone being 450, and was four storeys in height. The building was a fortress as well as a house, for it had no outside gates or doorways, and those who wished to enter or leave it had to climb its walls by means of ladders.

The ruins are remarkable for the large number of circular rooms built underground that could be entered only by means of ladders passed through holes in the ceiling. These are similar to the "kivas," or underground ceremonial chambers, of the Hopi Indians of the present day, who live in villages, scattered over the Southwest region, that in many instances are remains of the prehistoric settlements.

In many respects other Indian ruins of Colorado, Arizona and New Mexico are even more interesting than that of Pueblo Bonito, for they are found on almost inaccessible ledges on the faces of giant cli s. The first of these ruins to be discovered was Cliff Palace, in the Mesa Verde National Park, which is just within the southern border of the State of Colorado and contains so many ruins of cliff villages that it may almost be regarded as the centre of the prehistoric Indian civilisation.

Mesa Verde itself is typical of the scenery of the district. Its name means "green table," and it resembles a gigantic mountain with its top cut away. It rises from the centre of a great plain, and its summit is covered with dark green pines and firs. The Mesa is cut and scarred in all directions by canyons, and the cliff dwellers built their houses in caverns in the side walls of these gigantic gashes. Their homes therefore could only be reached by climbing up the face of the rock by means of handholes cut in its surface, or by crude ladders.

The buildings of a typical cliff village are of masonry, cemented and plastered over with adobe mud, which sets hard when dry. The living rooms are small and low, and are built up to the top of the cavern, giving structures that may be four or five storeys in height; and kivas are found in every village. Round wooden beams cut and hewed by means of stone axes form the ceilings of the rooms. Small saplings are laid over and at right angles to these beams, a covering of brush, bark or grass plastered over with mud and smoothed down providing the floor of the room above. Staircases are unknown, perhaps for lack of room; and it seems clear that crude wooden ladders were used to enable the inhabitants to pass from one storey to another.



Cliff Palace, the ruins of an ancient Indian village built on an almost inaccessible ledge of a cliff in Mesa Verde National Park, Colorado. The illustrations to this article are reproduced by courtesy of the National Geographic Society, Washington.

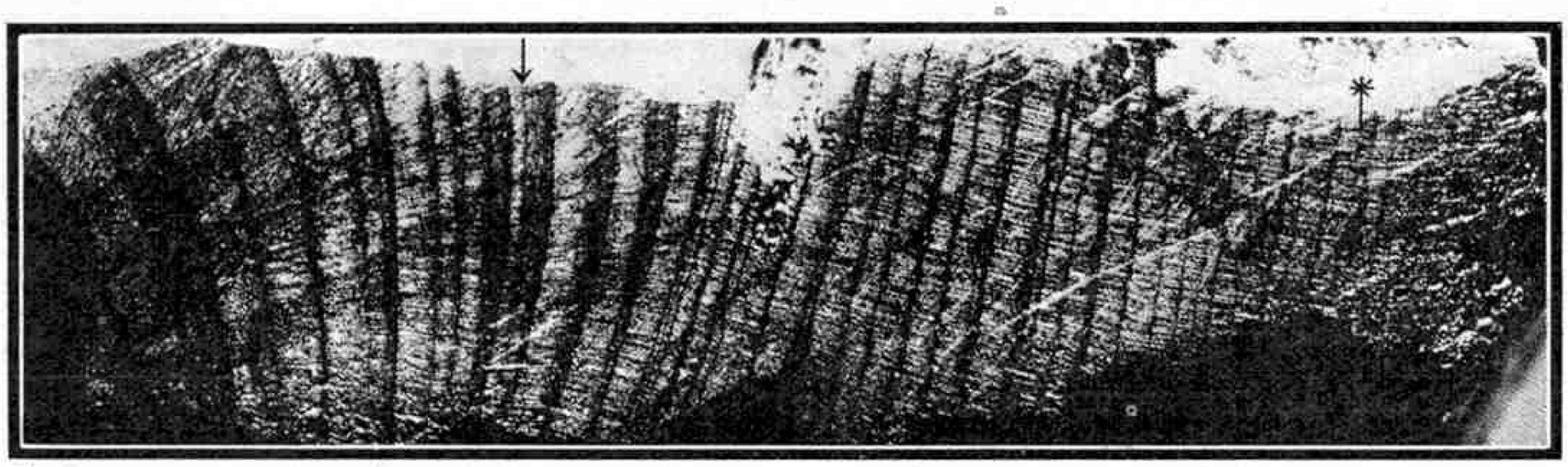
The builders of these astonishing dwellings seem to have been peaceful and industrious. They cultivated maize, beans, pumpkins, and cotton, and the remains of ditches suggest their employment of a regular system of irrigation in order to make the best use of the scanty rainfall of the region. They were skilful makers of pottery. Their cooking pots were crude and undecorated, but they made also beautiful storage jars of grey clay ornamented with geometrical designs in black. These ornamental jars are of many sizes and shapes, skilfully moulded with the fingers from plastic clay. The prehistoric Indian artists greatly favoured geometric patterns, for designs of this kind are to be seen also on textile fabrics discovered among the ruins of their homes.

Although the ruins of the cliff villages have been known for a considerable time, their exact ages have only recently been settled. The story of their dating is one of the most astonishing romances of science, for it began with enquiries into the nature of the spots on the Sun and their connection with the weather changes revealed in the annual growth rings of the pines, sequoias, and other trees of North America.

The key to the problem of dating the rings was found in the rings of the pines of Arizona. These rings are indeed true tree diaries, for each represents the layer of new wood added during a single growing season; and in them may be traced the marks of injuries due to flashes of lightning, forest fires, or the impact of neighbouring

trees that have been felled or blown down by storms. It is their revelation of changes in the annual rainfall that is of the greatest importance, however, for the rings formed in wet years are wider and softer than those grown when rain was scarce and the trees were thirsty. By counting the rings backward from those formed in the last years of a tree's life, therefore, it is comparatively easy to say when any definite event in its story happened.

Efforts to read the record of the rings of the pines of Arizona were made by the members of several expeditions sent out to explore the ruins of the cliff villages. In practically every pine tree examined there were regular alternations of groups of wide soft rings and hard narrow ones, showing that a series of rainy years was succeeded by a period of drought, and this again by a few years in which the trees were well supplied with water. There were 11 years between the middle of one rainy period and that of the next, and the regular changes in weather thus revealed by the trees is spoken of as the 11-year cycle. This remarkable sequence was only interrupted during the years between 1650 and 1725.



The fragment of charred wood from Show Low that provided the key to the calendar of the trees of the Southwest of the United States. The ring marked with an arrow grew in 1247, when the trees were thirsty, and that indicated by a star was formed in 1275.

Similar changes have been traced in the number and size of the spots, or dark areas, on the face of the Sun. How or why these spots influence changes in our weather, and thus bring about variations in the width of tree rings, is at present an unsolved mystery, but there is no doubt that rainfall on Earth is heavier when Sun spots are largest and most numerous. Even the years from 1650 to 1725, when the trees gave no evidence of the 11-year cycle, are a proof of the connection, for during that period there were no spots on the Sun.

It is easy to trace back the tale of the years represented by the rings of a tree cut down at any given date, and this has been done for hundreds of the pine trees in Arizona. The rings show more than a definite succession of wet and dry years, however, for the expert has learned to recognise the narrow rings formed in unusually severe droughts, or the groups of softer rings of varying widths formed in years when rainfall was abundant; and scrutiny of the rings of any tree enables him to say when it was a sapling and to give the years in which certain rings grew.

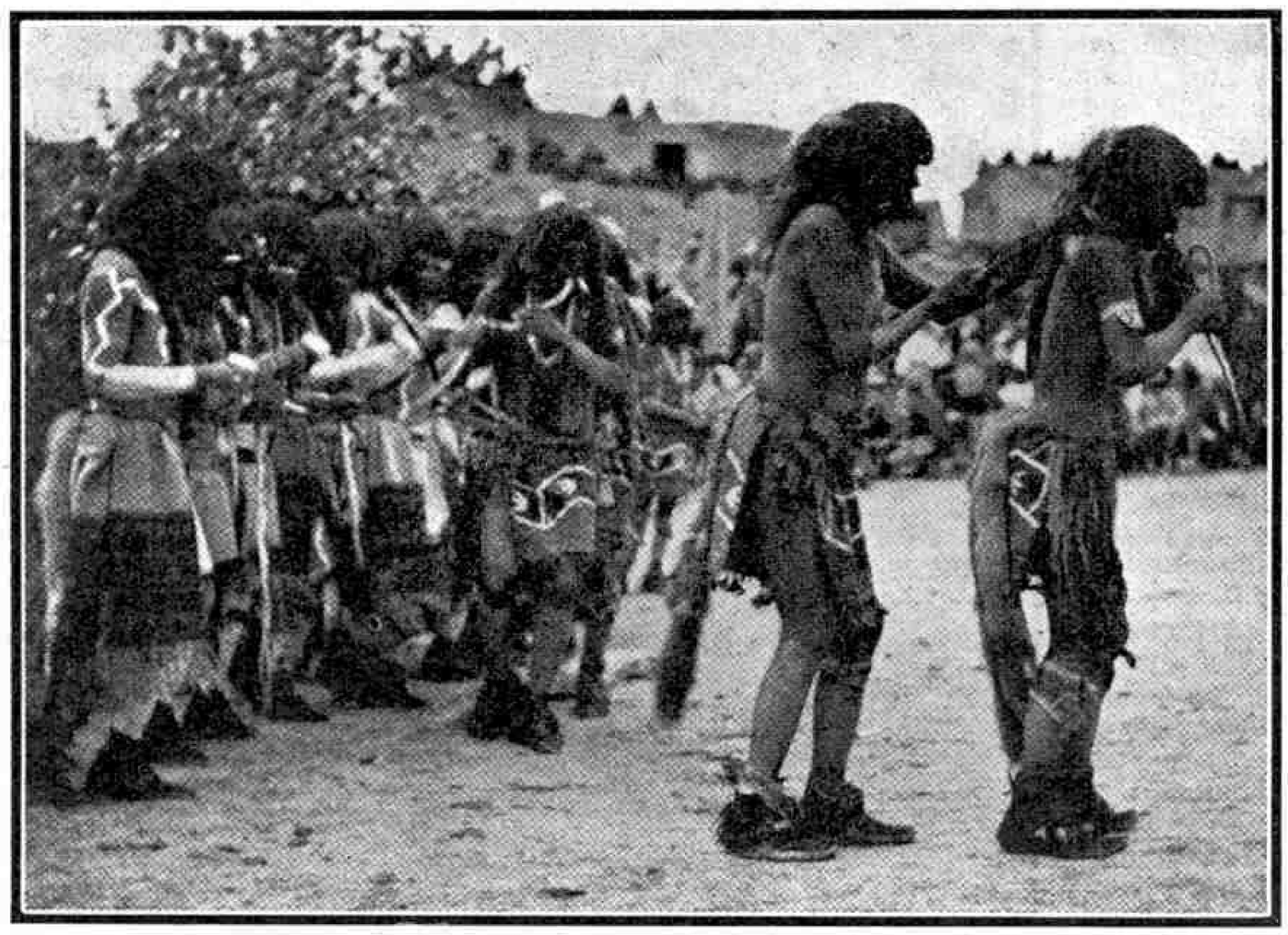
The story of the rings can be read also in logs and planks cut from trees that were felled years, and even centuries ago, for some of the pines of Arizona are more than 600 years old, and their records have provided a calendar beginning as long ago as 1380 A.D. It seemed a simple matter therefore to settle the ages of the beams used so freely in building the cliff villages by comparing the rings they showed so plainly with the tree calendar already worked out. Clearly the earliest date at which any building could have been erected is that of the outermost ring represented in its timbers.

The method was first tested with the beams from the great communal house at Pueblo Bonito. The remains were comparatively few in number, for many of the beams had rotted, and others had been used as firewood by pioneers and prospectors. Some had been charred when the ancient homes of the Indians had been ravaged by fire, but the record could be read in the fragments of charcoal remaining. No difficulty was anticipated, therefore, and the rings of many beams were carefully measured for comparison with the tree record.

Then came disappointment. The beams gave a fine series of rings, but these could not be matched with those of living trees, however, for they revealed variations in rainfall that did not correspond with those indicated by the rings of living pine trees. No dates could be given to them, therefore, and it was clear that the trees from which the beams had been cut had grown before even the oldest of living trees. This proved that Pueblo Bonito had been built before 1380, the earliest year to figure definitely in the calendar of the trees; and between that year and the date of the latest ring traced in the beams found in the remains of Pueblo Bonito there remained a gap.

The next step was to search other ruined Indian villages in the hope of discovering beams that would bring the story further down towards historic time. More than 100 excellent specimens of ancient timbers were gathered together from various sources, but again the eager searchers were baffled, for the rings did not match either those of living trees or the beams from Pueblo Bonito. Instead, they formed an entirely new third series covering about 180 years.

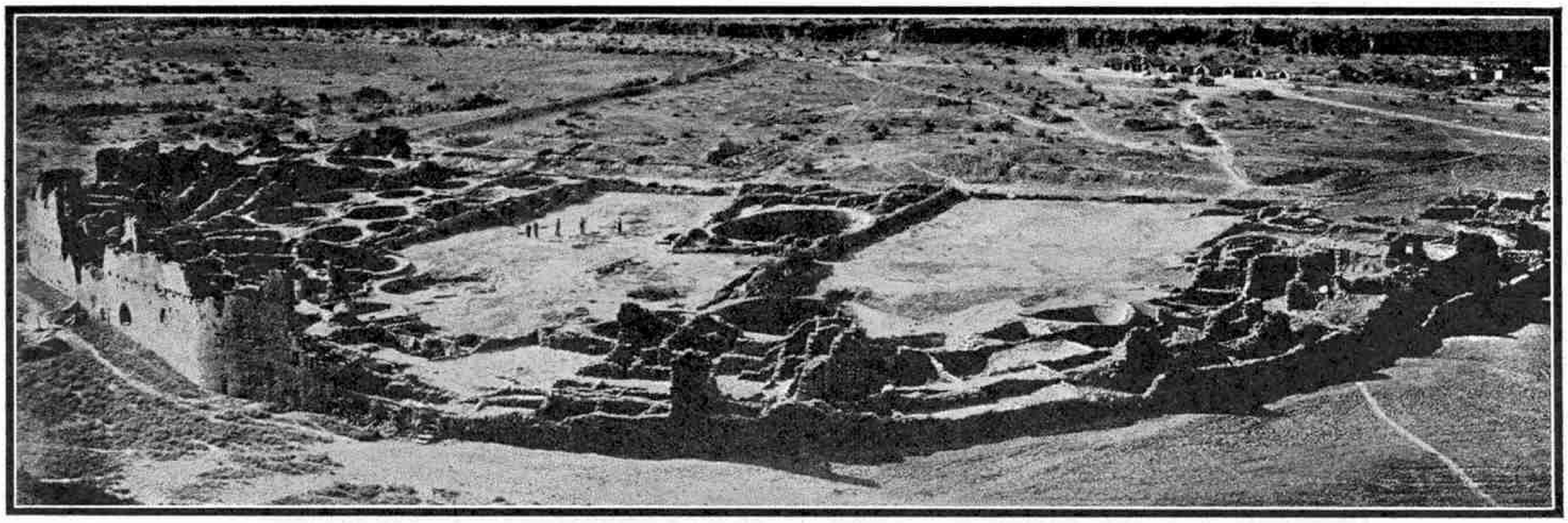
The ruins from which these beams came were known to have flourished later than the most prosperous days of the Pueblo Bonito settlement. In the calendar of the trees therefore the ring series obtained from them falls into place between that of the Pueblo Bonito beams and the modern one. Thus a great advance had been made, for the gap was now reduced to two shorter ones, and a hunt was started for logs that would form connecting links. Finally a typical cliff dwelling at Betakakim, in Northern Arizona, provided a Douglas fir log that bridged the first of the two gaps, for the older rings at its centre—illustrated in the heading block on page 190 were paralleled by the outermost rings of beams from Pueblo Bonito, while its outer rings matched those of the oldest beams from other ruins. Thus the rings of all the old beams of unknown date were now welded into a single series extending over a period of about 580 years.



Hopi Indians holding live snakes in their mouths during a ceremonial dance. The Snake Dance they are performing has been a part of their ritual since prehistoric times.

In order to complete the story it remained to fill in the gap between this series and that of modern trees. This could only be done by patiently and carefully exploring one ancient village after another in the hope of discovering an ancient beam showing the missing rings along with those already familiar, and a new expedition was organised to conduct the search. This was led by Dr. A. E. Douglass, an American scientist, who has devoted many years to unravelling the fascinating story of the tree rings.

Collecting ancient timbers from Indian villages is not a straightforward task. Many likely places are still inhabited by the descendants of the men who built them, and the more valuable timbers are found in the kivas, which are associated with religious ceremonies, and are therefore jealously guarded by the Indians. Wherever he went Dr. Douglass spared no effort to overcome the hesitation of the Indians by patiently talking them over or giving them suitable presents. In one village he gained the goodwill



of the inhabitants by presenting them with 20 dilapidated felt hats collected from his friends! These hats were highly appreciated by the Indians, who made them into masks for use in religious dances; and when he followed the gift with one of six turtles, he was readily given permission to examine a beam in their kiva that appeared likely to be valuable. This masterpiece of persuasion was wasted, however, for the beam added nothing to the tree ring calendar.

In other villages Dr. Douglass became very friendly with the Indians, and on one occasion he was invited to a bean dance in a large kiva. One of his assistants actually took part with the Indians themselves in this ancient ritual, the purpose of which is to persuade the spirits of the rain, dwelling in the mountains in the far west, to send the showers needed to cause newly-planted beans to grow.

After a prolonged search an ancient log that appeared interesting was discovered in an uninhabited section of the village of Oraibi, in Arizona. This beam was in an abandoned kiva that could only be entered through an opening in its ceiling, and it could not be removed without causing the structure to collapse. By means of a special boring tool a cylindrical core or section extending right across the log was extracted, and to the delight of the members of the expedition, this revealed a splendid series of rings. Some of these were already known, but near the core there were many new ones formed during the years for which there was no record. Its discovery did not fill the gap, but it was a magnificent help, and later the historic log was carefully removed for preservation.

The hunt was continued with renewed enthusiasm, and finally the attention of the scientific detectives was concentrated on Showlow, an abandoned Indian site in the south of Arizona. Charred logs had already been reported from this village, and it was evident that at one time a fire had occurred in the great communal dwelling, and the walls had collapsed on the burning ceiling beams and smothered the flames. The beams had continued to smoulder and in the absence of air had been slowly converted into charcoal, which had resisted decay.

The ruins of the ancient village were covered with modern houses, chicken runs, fences and stone walls; and scores of broken bottles and old tin cans were the first products of the search of the ground. Eventually charred beams and fragments still showing the marks of the sandstone tools of the prehistoric Indians were unearthed. One of these was a mere shell of charcoal, most of the unburned wood in its interior having decayed; and it was so fragile that it fell to pieces even after it had been carefully bound together with cotton twist. This unimpressive relic was carefully examined, for the rings were still visible in its charred remains. Working inward towards the core, Dr. Douglass traced the effects of great droughts in 1299 and 1295, and the log's story of these and other lean years coincided with that already learned from the beam discovered at Oraibi. The new beam carried the story further into the past, however. One ring, formed two years before the earliest recognised in the Oraibi beam, showed that 1258 was a hard year for the trees. Other rings nearer the core proved that 1254 was even drier, and that thirsty conditions prevailed in 1251 and 1247. Finally, at the very core of the charred log, came the central ring, and this revealed that the beam had begun its life in 1237, when Europe was still interested in the Crusades.

The illustration at the head of the page shows the ruins of Pueblo Bonito, or "Beautiful Village" in Chaco Canyon, New Mexico. This immense building was the home of about 1,200 persons and could only be entered or left by means of ladders. In the lower photograph is seen a Navajo Indian of Arizona, wrapped in a blanket of characteristic Indian pattern.

Then came a great surprise, for it was found that the innermost rings of the Showlow beam corresponded exactly with the later rings of the mysterious Pueblo Bonito series. Thus at last the troublesome gap was filled, and the story of the trees was completed by the discovery of this charred old stick in the ruins of Showlow.

The 551st of the 580 years of previously unknown date during which the cliff villages were built was the dry year of 1251 in the Showlow beam calendar. The old series of years therefore began in 700, when the earliest log recovered from Pueblo Bonito was a sapling. As this log was 219 years old when cut, it follows that the building of the great communal house-fortress must have begun in 919, nearly 600 years before Columbus discovered the New World.

One by one the dates of other prehistoric Indian villages were then tracked down, and the story of their development was traced. Pueblo Bonito itself seems to have reached its golden age in 1067, and was flourishing as late as 1127, for trees cut down in that year were employed in extensive building operations. Cliff Palace is believed to have been inhabited as early as 1073, but other villages of the Mesa Verde were occupied in 1216 and 1262. Showlow is of particular interest, as it yielded the charred beam that supplied the key to the problem; and it seems to have been an important centre of native Indian civilisation from 1174 to 1383.

Thus the mystery of the ages of the prehistoric villages of the Southwest was solved. They were built by peaceful Indians, who dwelt in them for hundreds of years before Columbus dreamed of crossing the Atlantic Ocean in the hope of discovering a New World. This early civilised race had already begun to decay when the Spaniards extended their conquests to Mexico, however, and was hard pressed by the Apaches and other fierce tribes from the north. Unable to retreat southward because of the advance of the Spaniards, the Indians were trapped between two foes, but the survivors continued to cling to their homes, the timbers of which have revealed so much of their history.

Much of the information in this article has been drawn from the "National Geographic Magazine," published by the National Geographic Society, Washington, U.S.A.; and we have to thank Dr. A. E. Douglass for his courtesy in allowing us to make use of this material and to reproduce the illustrations.

The Story of Artificial Silk

II.—Chardonnet and Other Processes

By W. F. Harrison

COUNT Hilaire de Chardonnet, whom I described last month as the first individual to make the production of artificial silk a commercial success, happened in his younger days to be a pupil of the famous chemist Pasteur. At that time Pasteur was investigating certain diseases to which the silkworm was subject, and the young student was thus enabled to study the interesting creatures at first hand, and under expert guidance. It was probably this experience that determined his career. It certainly influenced his early choice of a basic material for his process, and besides providing him with a complete knowledge of Nature's methods gave him a model that he strove faithfully to reproduce by such mechancial means as he could command.

Following in the footsteps of Audemars and others, Chardonnet set himself to produce a solution that could be made into an imitation silk. After years of patient research he accomplished this by converting wood pulp made from the trunk and limbs of the mulberry tree, the food plant of the silkworm, into nitro-cellulose, and dissolving this in a mixture of alcohol and ether. This solution was filtered, aged or ripened, and forced at high pressure through fine orifices to form a filament that would harden at once. Then, grouping together several such filaments so as to form a thread, he passed them through guides, wound them on bobbins, eliminated the nitrate, and subjected them to the ordinary course of bleaching, washing, twisting and reeling.

Thus it will be seen that Chardonnet unified and systematised the hitherto spasmodic attempts made on the Continent to produce an imitation silk. He had to contend with many technical difficulties, in particular that of de-nitration, but in spite of these, and of the fact that the new fibre in the earlier stages of production was highly inflammable, and actually more expensive than silk itself, he persevered, and ultimately made "Soie de Chardonnet," an article of commercial value in the markets of the world.

Chardonnet had spinning machinery built to his own designs by Mertz of Basel, and in 1884 he founded in his home town of Besançon, in the East of France, the "Société Anonyme pour la Fabrication de la Soie de Chardonnet." This is generally recognised as being the first artificial silk factory in the world, although on some grounds priority might be claimed for the little shed belonging to Sir Joseph Wilson Swan at Bromley in Kent. The factory at Besançon operated until 1914, and from it developed others for the making of imitation silk by the same method, or modifications of it, in Switzerland, Germany and Belgium.

During the first few years of his operations at Besançon, Chardonnet saw nearly the whole of his capital of 6,000,000 francs swallowed up without any return, but after exhibiting fabrics made from "Soie de Chardonnet," and making public the details of his process, which at first he had deposited under seal with the Committee of the French Academy of Science, he was enabled to recapitalise his business at the original figure. He had set out to produce for manufacturing purposes a new commodity in textiles, and he had succeeded. The hatmakers and the smallware manufacturers were the first to realise the possibilities of the new fibre, and when their lead was followed by others, Chardonnet silk became an accomplished fact and the Besançon factory a paying concern.

It has been stated that the earliest spinning solution made by Chardonnet had for its basis cellulose obtained from the wood of the mulberry tree. In this, and in his preference for what is known as the dry method of spinning, he endeavoured to imitate Nature as closely as possible. In later years he used cellulose from other vegetable sources, and finally from cotton, which has long been recognised as the best, one might say the only, raw material adapted to the Chardonnet process. The cotton used for this, as well as for some other processes of which a brief mention will be made, is known as linters, and is the residue from one of the early mechanical operations for separating the fibre from the seed. As linters is a by-product, the amount available is determined by the weight of the cotton ginned annually. Mixed with soft waste from high-grade cotton extracted during processes preparatory to spinning, it is used also extensively in the making of surgical lint and gun-cotton. For all these purposes it is subjected to a course of bleaching and washing to clear it from all impurities.

Rayon of the highest grade is made from American cotton linters, and the cleaner the cotton in the first place the less vigorous is the bleaching treatment required. American cotton, it may be noted, is nearly 90 per cent. cellulose, but the Egyptian varieties and Eastern cotton generally contain a less proportion of this valuable substance.

For use in connection with the Chardonnet process cotton is immersed in an electrolytic bleaching liquor, and while still in a wet condition is treated with nitric acid, water, and sulphuric acid. It is then dried in stoneware vats and afterwards reduced to pulp by rotating knife blades. The spinning solution is made by dissolving this pulp in a mixture of ether and alcohol, a process that takes about 20 hours. The resulting honey-coloured liquid is filtered by passing it through cotton wadding held in silken gauze, after which it is ripened and the air bubbles are extracted.

The cellulose nitrate is spun by being forced through small glass spinning tubes, in shape not unlike syringes, but of extraordinary strength in order to withstand the pressure of 40 to 50 atmospheres. It may be spun dry, that is in an enclosed vessel and hardened or set by contact with hot air; or wet, by being forced into a coagulating bath. Chardonnet held that the former gave the best results, but it is significant that one of the principal concerns operating the nitro-cellulose system eventually adopted the latter method.

As the filaments are spun they are collected together to form

Miles of Timber. An impressive view of a Canadian forest. This photograph and the upper one on the next page are reproduced by courtesy of the Canadian Government.

a given size of thread or denier, drawn through a guide, and wound on to a wooden spool that is rotated at a definite speed in order to stretch the newly-made rayon. It is then re-wound on to smaller spools, twisted, and reeled into hanks, in which form it is de-nitrated by being subjected to the action of sodium hydrosulphide or calcium hydrosulphide.

In addition to the nitro-cellulose system associated with the name of Chardonnet, there are two other methods of spinning in which cotton is the basic material; these are the cuprammonium process and that of cellulose acetate. The first-named has been adapted to spin either the coarse fibres of rayon by the inexpensive Glanstoff method, or those of the finest deniers by that associated with the name of Bemberg. In the former the raw cotton is cleansed by boiling it in a solution of caustic soda, after which it is washed, bleached, washed again and stored in a damp state. It is then mixed with a cuprammonium solution in a water-jacketed drum provided with a blade to keep the contents well stirred. After six or eight hours the cotton has dissolved into a dark blue liquid, and this is filtered through gauze and fed to the spinning machine.

Log jam on a Canadian river. Setting free the thousands of logs held up in jams of this kind is one of the lumberjack's most dangerous tasks.

At what might be called each "head," and there are several of these at each side of the machine, the liquid flows through a tap into a comb that distributes it into about 20 glass tubes or jets. The tubes are immersed in a heated bath containing caustic soda and a small amount of sugar in solution. The 20 streams of solution form into filaments at once in the setting or hardening bath, and they are simultaneously drawn upward, collected into a thread, and wound round glass bobbins at such a tension as will attenuate or stretch the filaments without breakage. When a sufficient quantity of rayon has been wound on, the glass bobbins are doffed and replaced by others to ensure continuity of production. The rayon is then freed from the effects of the copper by rinsing in a bath containing about two per cent. of sulphuric acid.

For the spinning of the finer filaments of cuprammonium rayon by the Bemberg process the cotton is first boiled with caustic soda and soap. After being bleached and washed it is reduced to pulp by mechanical means similar to those used in the nitro-cellulose process; and at the same time it is mixed with cupric hydroxide. The spinning solution is next filtered and then passed under slight pressure through a nozzle or spinneret that may contain up to 80 fine orifices, into water flowing in the same direction as the filaments. The latter are not solidified at once, but are drawn through a trumpet or funnel into the coagulating bath proper, and at the same time are subjected to a tension that stretches them to fine limits as they are drawn forward to the winding apparatus.

Thick sheet of wood cellulose automatically cut into rectangular pieces of convenient size for transport to the rayon manufacturer. Photograph by courtesy of Riordon Sales Corporation Ltd., Montreal.

The last variation of rayon production from a cotton basis to be noted is that now known by the name of Celanese. This system differs from the others in that the resulting fibres are a compound of cellulose, or a secondary cellulose acetate soluble in acetone. The cotton linters, after being purified and reduced to pulp, are treated with acetic anhydride, dissolved in acetone, and spun by the dry method in an enclosed receptacle, where the filaments are set or fixed in warm dry air instead of a coagulating bath. Although one of the oldest spinning solutions to be experimented upon, cellulose acetate had to wait until the end of the Great War for its development. Among the large factories devoted to various purposes connected with the War was one at which dope for the dressing of aeroplane wings was made, but at the conclusion of hostilities there was no further use for this product on so vast a scale. The huge buildings were acquired by the British Cellulose and Chemical Company, and the plant was converted for making artificial silk by the acetone soluble acetate process as developed by Mr. H. Dreyfus.

Although cotton has been shown to be the basic material used in all the foregoing processes, it is responsible for probably less than 15 per cent. of the world production of rayon. The bulk of this is now made by the viscose process from wood pulp of the highest grade, known to the trade as bleached sulphite wood cellulose. This process of forming a solution of cellulose was discovered and patented by Messrs. Cross, Bevan and Beadle in 1892, and the method of its spinning was evolved by Stearn. The cellulose was first digested in a strong solution of caustic soda and then treated with carbon bisulphide. The resulting cellulose "Zanthate" was then dissolved in a weaker solution of caustic soda and spun, and the resulting raw cellulose filaments were bleached and washed. In the early days of the process the twisting of the filaments gave an immense amount of trouble, and this led to the invention of the centrifugal spinning box, or pot, by Mr. C. F. Topham, once a young glass blower employed by Stearn at Birkenhead in making bulbs for the first Swan lamps. The centrifugal spinning box may be described as an epoch-making device which, more than anything else, gave an impetus to the new industry, and pointed the way to the large scale production of rayon by the viscose process.

The spinning solution was forced, as in previous instances, through spinnerets into a coagulating bath, and from there a number of filaments passed over a godet, or glass roller. Instead of being wound round it, however, they were dropped vertically into a rapidly rotating pot that drew them forward, twisted them together, and formed them into a tightly-wound cake or cheese,

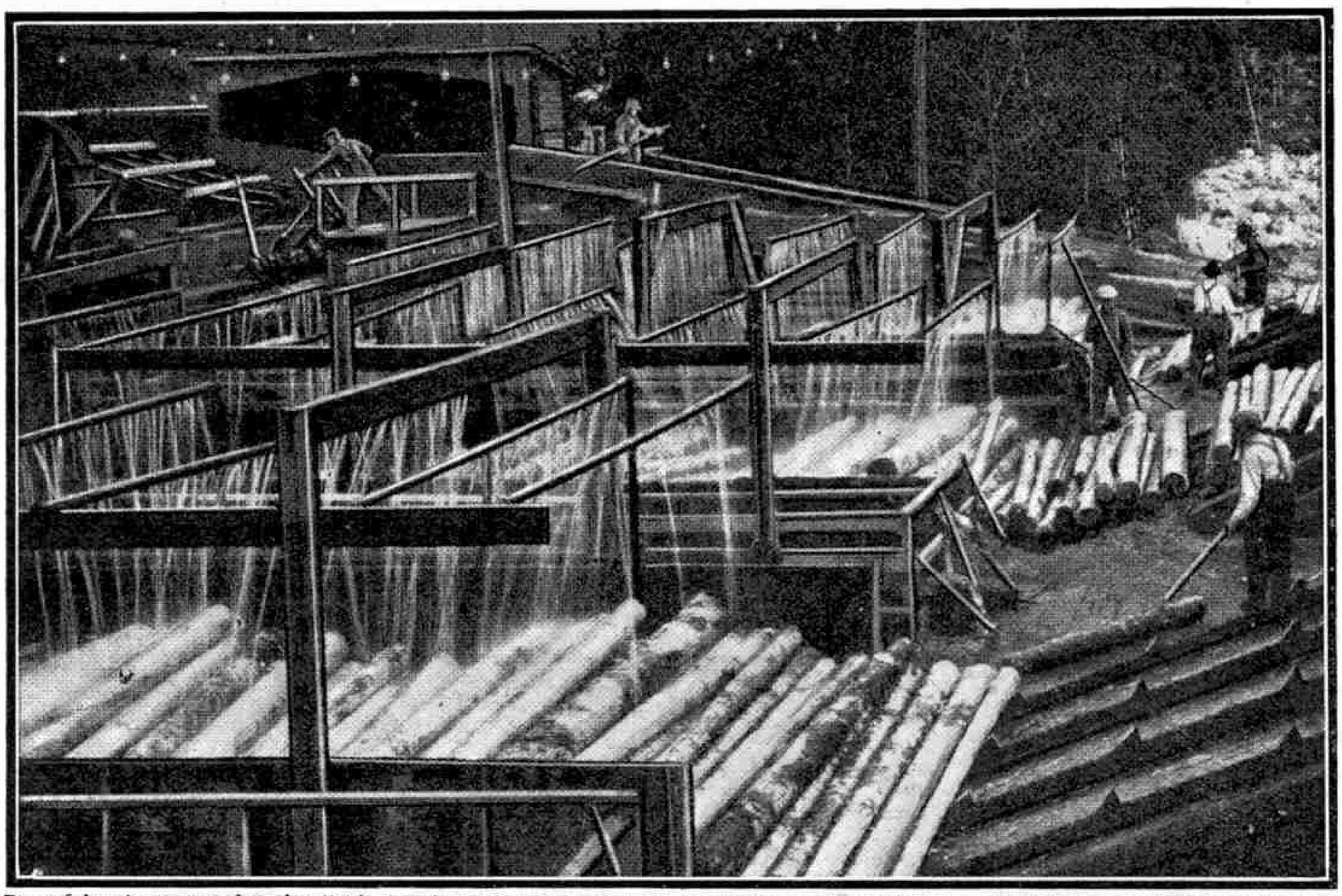
from which the resulting threads could be wound or reeled. It was in effect a mechanical device which, at a speed of from 5,000 to 6,000 r.p.m., made a cocoon comparable to that which Nature had formed in her own leisurely fashion.

A syndicate was formed to manufacture artificial silk at Kew under the superintendence of Stearn, assisted by Topham, but after a short period of working the patent rights attached to this system of viscose spinning were acquired by the firm of Samuel Courtauld and Company, who afterwards began production on a large scale at Coventry. The subsequent development of this firm is too well known to need much recapitulation. It is the largest concern of its kind in the world, having six producing factories at Coventry, Flint and Wolverhampton, and processing, weaving and knitting establishments in Essex, Yorkshire and Lancashire.

The viscose system of rayon production as developed by the Courtauld Company has been purposely left for a detailed description, since in point of volume it has acquired a supremacy in the world's markets. At present there are 143 firms making rayon by the viscose process, as against 28 engaged in its production by the acetate method, 13 on the cuprammonium system, and only two operating on the later Chardonnet formula, Besançon's only factory now producing rayon by the British viscose method.

Although the viscose method predominates so largely in modern rayon production it really absorbs but a small percentage of the wood pulp made in different parts of the world. The fact is that, in spite of the enormous amount of timber available in various countries, comparatively little of it is adapted for conversion into rayon. Spruce and pine are mostly used for making the best pulp, and as the demands of the paper trade are so great that over 3,000,000 spruce trees are cut down to supply the paper used yearly in New York alone, it is natural that some anxiety should be felt regarding the amount of spruce available in future years.

For conversion into rayon there is no tree like the spruce, as it is the richest in cellulose, and is the one most free from deleterious matter. In good sound trees there is from 52 to 55 per cent. of this substance, the remaining constituents being water, lignum, fats and resins. Spruce is found in abundance in Russia, the Scandinavian countries, Newfoundland, the United States and Canada, but the forests of Northern Canada yield timber of the quality most suitable for conversion into the sheets of bleached sulphite wood cellulose that form the basis of the viscose rayon industry. Without attempting to estimate the world production of wood pulp, it may be sufficient for the present purpose to mention that in the last-named region one factory alone, that of Kipawa, Quebec, turns out annually 100,000 tons of bleached sulphite wood cellulose for use in the making of viscose rayon.



Powerful water sprays cleansing the logs and washing away the bark as it is mechanically removed. Photograph by courtesy of Riordon Sales Corporation Ltd., Montreal.

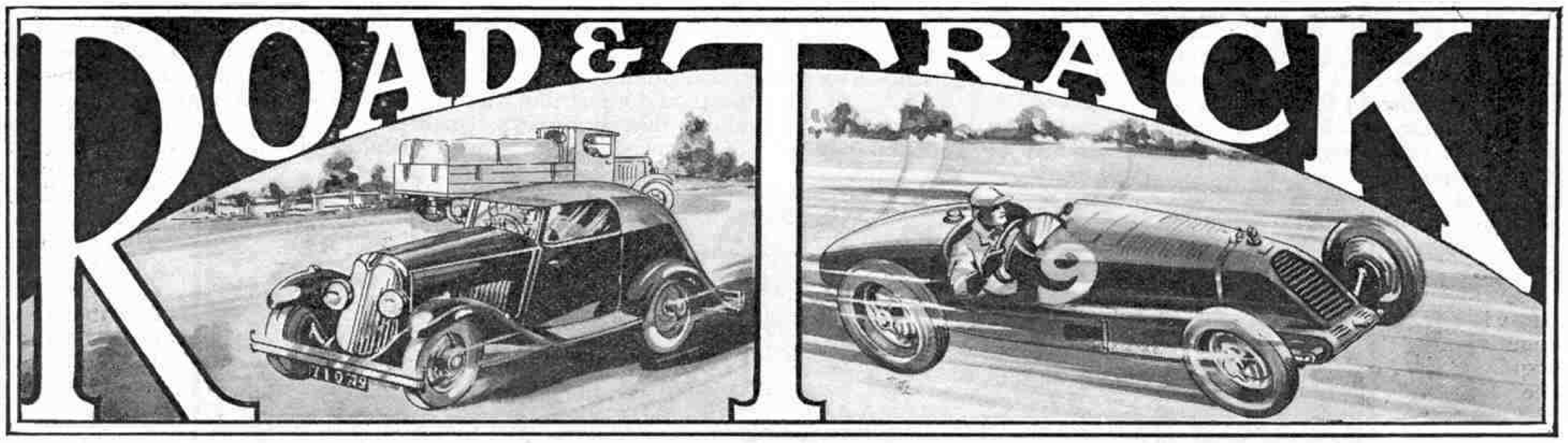
The felling is done in the winter time, and under the severest climatic conditions. Electric power is almost universally used in the cutting down of the trees and the sawing of the trunks into logs. These are taken on sleighs to the banks of the nearest river, and when the thaw comes in spring a million logs are often ready to be rolled into the water and floated down to the saw-mills, where they are hauled from the river by a jack ladder and subjected to careful inspection. The bark is then removed and the timber stacked for seasoning, air being allowed to circulate freely among the logs, so that each, by a natural and gradual process, attains the same degree of dryness.

After seasoning, the knots and decayed timber are removed, and the logs are cut up by rapidly revolving circular saws into chips measuring about 1 in. by ½ in. by ¼ in., and these are passed to the storage bins. The chips are now ready to be dropped into the digesters, huge upright cylinders with a capacity of from 10 to 40 tons, built up of boiler plates and lined on the inside with acid-proof tiles. Here the chips are "cooked" or boiled at high pressure in a solution of calcium bisulphite, with a certain amount of sulphur dioxide.

Skidding logs from a sledge into the river that carries them down to the pulp mills. Photograph by courtesy of the Canadian Government.

The sulphite liquor is prepared in tall concrete towers, lined with acid-resisting brick and filled with limestone, over which water is sprayed; while sulphur dioxide, obtained by burning pyrites of sulphur in rotating ovens, passes upward. The water absorbs the sulphur dioxide and forms sulphuric acid, which decomposes the limestone. Carbon dioxide escapes, while calcium bisulphite is formed at the bottom of the towers, and is pumped from there to a reservoir, ready to be supplied to the digesters.

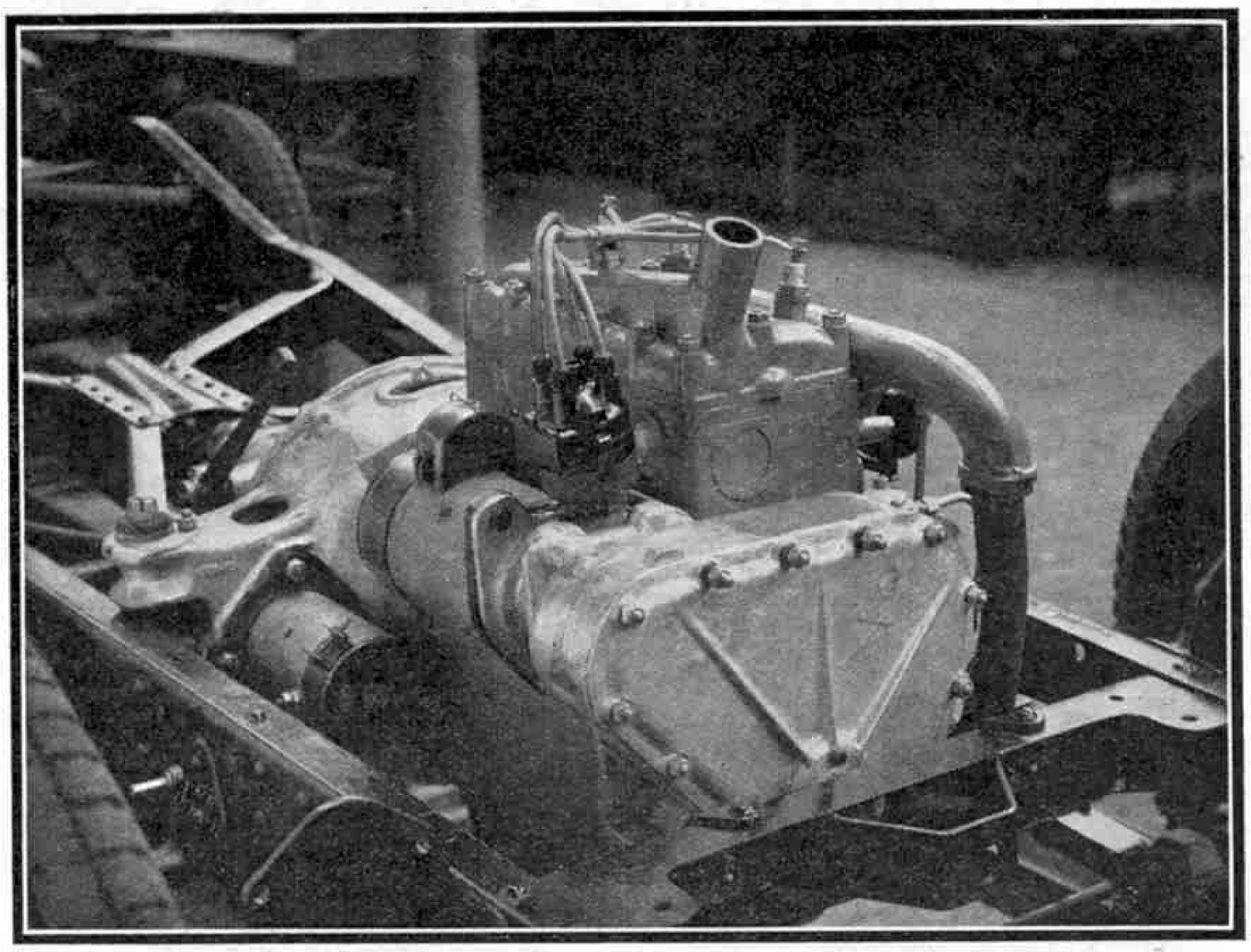
In due course the digesters are filled with spruce chips and the solution of calcium bisulphite. They are then heated together to about 110 deg. C. either by direct or indirect steam, in order to decompose the wood and remove the impurities, such as lignum, fats and resin. In some processes the steam may be cut off for a period to allow the liquor to penetrate the wood thoroughly. Following this a full boil may be given for nine or 10 hours at from 140 to 150 deg. C., and at a pressure of (*Continued on page 248*)



THIS year promises to be exciting in regard to speed work on both road and track. One coming event that will contribute to this excitement, and has already aroused great interest, is the attempt on the British Empire land speed record to be made this month at Southport.

The present record is held by Sir Malcolm Campbell, who in 1929 registered a speed of 217 m.p.h. at Verneuk Pan, South Africa, in his famous car, "*The Bluebird.*" The new effort is to be made by Mr. Jack Field, a well-known Southport racing motorist, and in his attempt he will use "*The Silver Bullet,*" the racing car originally built by the Sunbeam Company at a cost of £20,000 for Mr. Kaye Don's attempt on the world's land speed record at Daytona Beach, Florida, in 1931. Mr. Don then attained a speed of 188 m.p.h., but difficulties of many kinds that arose prevented his effort from being successful. The car is 32 ft. in length and weighs six tons. Its giant engine develops 4,000 h.p., and it is expected that the attack on the record will be made on a course seven miles in length, stretching from Southport Pier to Freshfield.

A second speed effort in which readers will be interested is also to be made this month, when Mr. C. J. P. Dodson, a famous motor-cyclist who has been particularly successful in Tourist Trophy races in the Isle of Man, will make an attempt on the world's speed record for motor cycles with engines of 250 c.c. capacity. In order to be successful Mr. Dodson will have to exceed a speed of 101 m.p.h.



The compact unit fitted in the B.S.A. Ten, one of the cars in which the fluid flywheel is incorporated. Photograph by courtesy of B.S.A. Cycles Ltd.

Conquering the Motor Racing World

Even more interesting events may be looked for when the motor car races of the coming season are decided, for rivalry among famous drivers promises to be intense, and keen struggles are to be expected. One of the greatest contributors to the excitement no doubt will be Mr. Whitney Straight, who has set out in a determined manner to conquer the motor racing world. Mr. Straight achieved a wonderful reputation as a skilful and daring driver before reaching the age of 21 by snatching time from his studies at Cambridge in order to take part in famous races on track and road in Great Britain and on the Continent. He has now taken the remarkable step of forming a syndicate, known as Whitney Straight Ltd., for the purpose of organising one of the costliest fleets of racing cars that has ever been assembled. He has already obtained five Maseratis of the latest design, and as these are reputed to be the fastest Continental cars, he should score many successes in the races for which he is entering them.

Mr. Straight does not intend that his syndicate shall have many idle moments, for he has planned to take part in 37 races on the Continent, including every event that is regarded as worth winning by the most famous of motor racing drivers. He will have the assistance of a large staff of engineers and mechanics, and among those who will be at the wheels of his entries when he himself is not driving are many young British racing men of acknowledged skill.

The great programme that has been planned for the syndicate will make it necessary for Mr. Straight and members of his staff to undertake long journeys, for there will be little time to spare between some of the events in which he has entered. He has therefore obtained a fast aeroplane, and this will be used by him for business purposes in connection with his programme.

Motor Cars Easier to Control

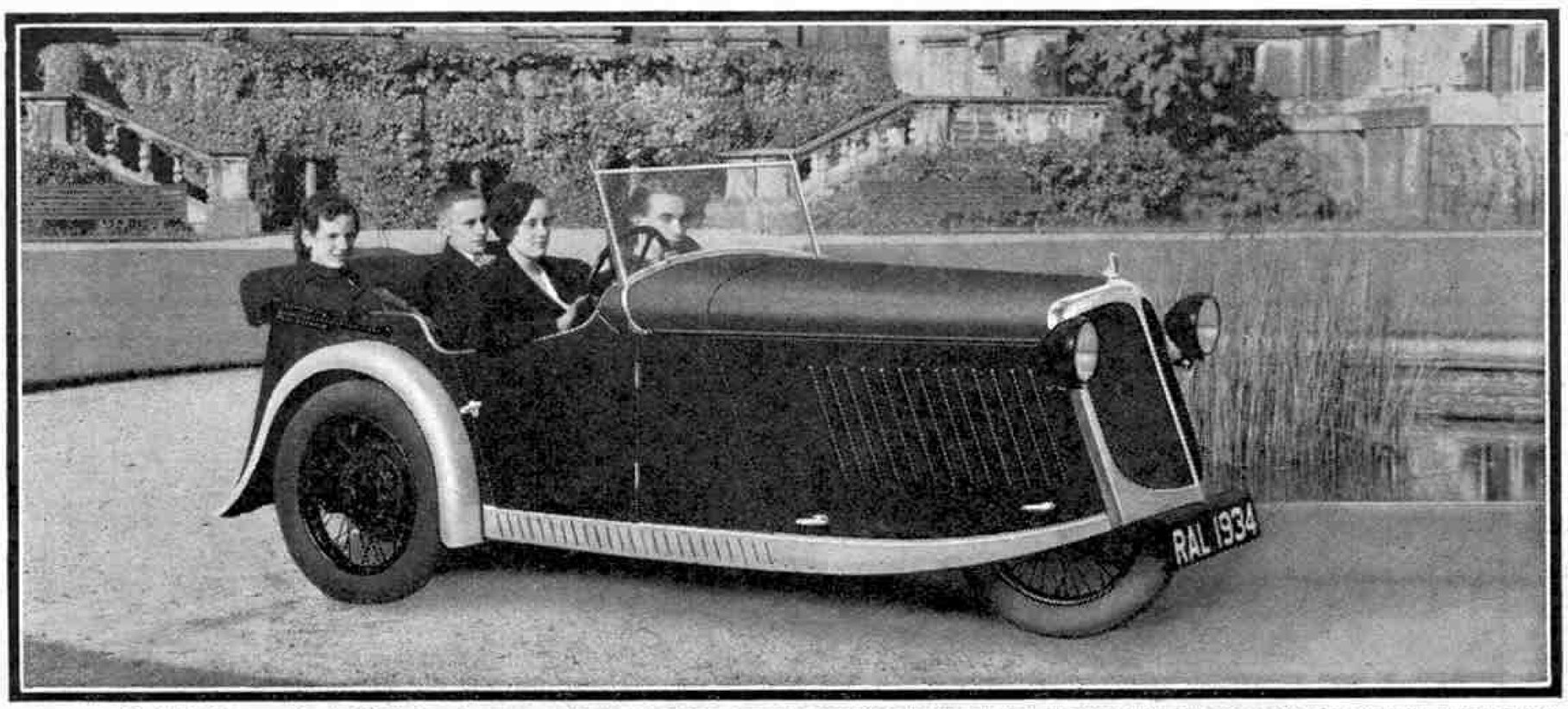
Everybody who has followed the development of the motor car in recent years will have realised what enormous strides have been made in design. The intensive racing programmes that have aroused so much interest have contributed largely to the increase in our knowledge of the capabilities of the internal combustion engine, and of the principles behind the design of speedy and reliable cars. It is very largely as a result of information thus gained that modern cars have engines that develop far more power for their size than those of a few years ago and, what is more important to the owner-driver, they have much simpler controls and are less tiring to drive.

Ease of control has been brought about by the introduction of various devices, among which one of the most interesting innovations is the Daimler fluid flywheel, which has now thoroughly justified itself in practice. Externally this resembles an ordinary enclosed clutch, but actually it consists of only two parts, the flywheel or driving member, and the part that is driven by it. The first of these parts is connected to the engine crankshaft, and the other is coupled to the shaft of the gear-box, and the two are never in actual contact, the narrow gap between them being filled with engine oil. It is this oil by means of which power is transmitted.

Both the driving and driven members have cup-shaped pockets, separated by radial webs, on the faces that are opposite to each other. As the driving member rotates, the oil in its pockets is flung outward towards its circumference by centrifugal force. In its outward course it follows the curves of the pockets, and is thus caused to impinge upon the pockets of the driven member. These pockets are so shaped that it is carried back to the centre of the flywheel, and it is then again flung outward to travel over the same course repeatedly. When the engine speed is low, the oil slips round the pockets, but at ordinary speeds the amount

of slip is insignificant, and the movement of the flywheel is communicated to the driven member. Full turning power is developed immediately on pressing the accelerator, even when the car is in top gear.

In addition to its simplicity and reliability, the fluid flywheel has the great advantage that it has a cushioning effect. This reduces wear and tear throughout a car fitted with it, and therefore leads to considerable saving in maintenance and depreciation cost. Its action is automatic, and no attention is required beyond occasional adjustment of the oil level. There is no danger of serious loss of oil by leakage, because the glands that retain it are not subject to great pressure, and replenishment is required far less frequently than in the case of a gear-box or back axle as fitted on an ordinary car.



The new Raleigh three wheeled light motor car, which seats four people comfortably and can scarcely be distinguished in general appearance from a "baby" car. The chassis of the car is shown below. The engine is rated at 7.42 h.p. and is taxed at only £4 a year. Photographs by courtesy of the Raleigh Cycle Co. Ltd.

The illustration on the previous page shows the 10 h.p. four-cylinder power unit of the B.S.A. Ten, one of the cars to which the fluid flywheel is fitted. This car is available in many interesting versions, among which are several four-door saloons and a sports coupé of pleasing lines. The Tickford Foursome is a model of special interest, for it offers a choice of three types of bodywork, and the change from one type to another can be made easily and quickly. It can be used as a completely closed car, and then is as weather-proof and comfortable as a saloon with a fixed top. It becomes a coupé de ville on releasing the front extension from the windscreen, rolling it back and fixing it by means of a strap to the rear standing pillar, and by turning a removable handle it can quickly be converted into an open four-seater.

Independently Sprung Road Wheels

Another interesting development is the introduction of independently sprung wheels. As yet experts differ in their opinions on the advantages and disadvantages of this system, but it is significant that 32 per cent. of the cars exhibited at the Berlin Motor Show in February of last year incorporated it, and that practically every famous American maker has now adopted it.

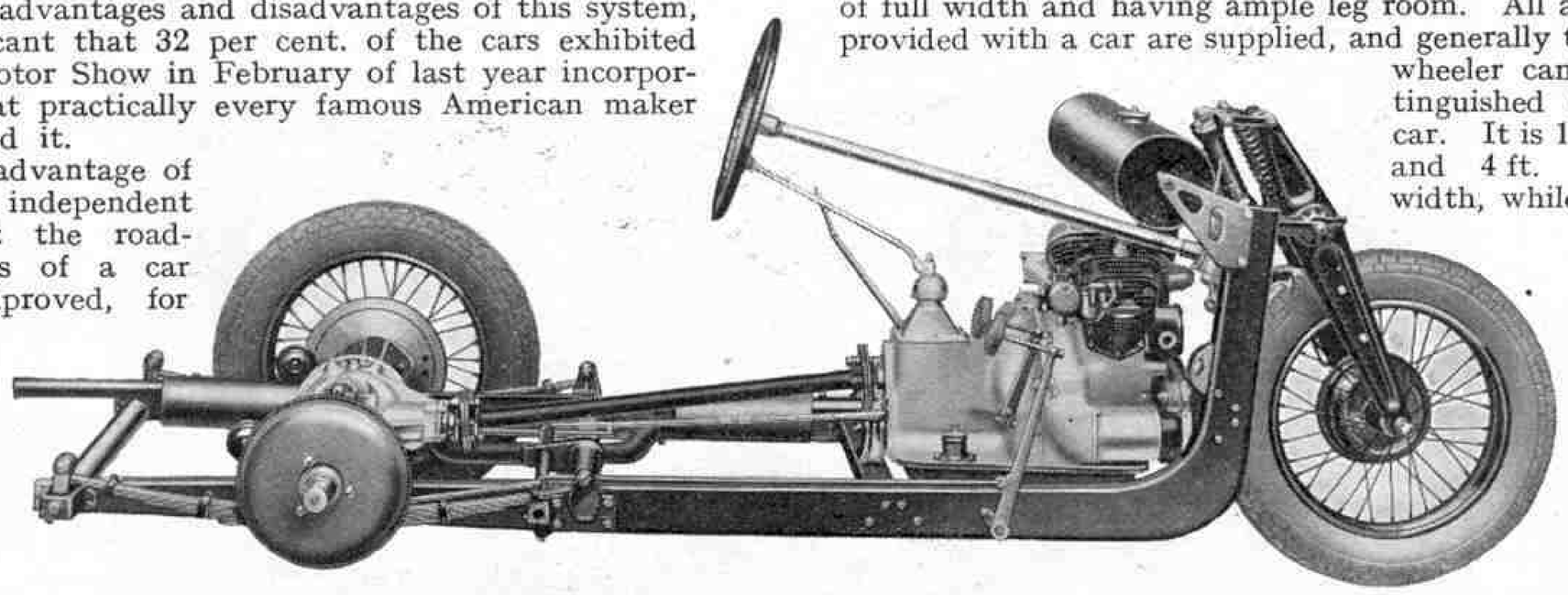
The greatest advantage of wheels with independent springs is that the road-holding qualities of a car are greatly improved, for the wheels grip the surface much better when acting independently than when coupled in pairs by means of an axle. The greatest danger in their use is due to the fact that the springs have to sustain the entire braking effort, and are liable to give way unless they are very carefully designed. Another difficulty is that of obtaining a reliable drive on the rear wheels, for which purpose two universal joints are usually employed. The mechanical difficulties can be overcome, however, and it is interesting to know that the Daimler-Benz Company of Stuttgart, Germany, now fix independently sprung wheels to all their models with engines up to 4,000 c.c. in capacity. This points to an increased use of the system in the cars of the future.

During the Motor Exhibition at Olympia, London, last year, an increased demand was experienced by certain manufacturers for their larger models. This is an interesting development and there are many good reasons for it. In the first place a large car, of say 20 h.p. to 25 h.p., is more pleasant to drive than a smaller one. Its reserve of power and the absence of noise at reasonably high speeds are satisfying, and many cars of this class have an extraordinarily long life, probably because they seldom work at full capacity. They are also more pleasant to ride in, for the full-size coachwork allows ample room for movement, and as the entrances are wide, lofty and direct, there is no necessity to squeeze into the car or to scramble awkwardly out of it.

A good example of this type of car is the "Long Twenty" Armstrong-Siddeley limousine. This car has a specially long wheelbase, and is equipped with a Triplex glass division behind the driver, and two occasional seats, both facing forward, in the rear compartment. These seats make contact with each other so neatly that three passengers can sit abreast on them. The car cruises comfortably at 55 m.p.h. to 60 m.p.h. and has a maximum speed of more than 70 m.p.h.

The Raleigh Three-Wheeler Sports Tourer

In spite of the growing demand for large cars, however, there is no doubt that smaller models will continue to retain their immense popularity, if only because of the extraordinary efficiency of their engines and their low running costs. What may be regarded as an addition to this section attracted keen interest at the Motor-cycle and Light Car Show at Olympia last November. This was the Raleigh Sports Tourer, a three-wheeler that differs from previous popular cycle cars in having the single wheel at the front. In the new Raleigh model this wheel is employed for steering, and there are two driving wheels at the back, as in an ordinary car. Full car-type springing and body-work is incorporated and four seats are provided, the two rear ones being of full width and having ample leg room. All accessories usually provided with a car are supplied, and generally the Raleigh three-wheeler can scarcely be distinguished from a "baby" car. It is 11 ft. in full length and 4 ft. 6 in. in overall width, while the height with the hood raised is 4 ft. 8 in.



The front wheel of the Raleigh is fitted on an attachment similar to the front fork of a motor cycle, and is steered through a normal car-type worm and sector steering gear. The makers state that steering by one wheel is theoretically correct, and that in practice it results in light and accurate steering. The engine, clutch and gear-box are built in one unit directly behind the wheel. The engine is rated at 7.42 h.p. and develops more than 17 b.h.p. at 3,000 r.p.m.

A feature of the Raleigh Sports Tourer is that it costs only 90 guineas and that the tax is only £4 a year. The petrol consumption is one gallon for between 50 and 60 miles, and between 1,500 and 2,000 miles can be covered on a gallon of oil.

More than two years of continuous experimental work and testing were carried out before the car was produced. From the results of these experiments the makers have been able to state that skidding is almost absent under even the worst conditions.

Laying a 1,200-Mile Pipeline

Developments in the Iraq Oilfields

THE gigantic scheme that is now in progress with the object of commercialising the vast oilfields of Iraq is the culmination of negotiations extending over 30 years. They were interrupted by the War, but were resumed after Iraq had ceased to be a Turkish province. Largely as the result of the inspiration and leadership of Sir John Cadman, an agreement was made with the Iraq Government for the concession now being developed by the Iraq Petroleum Company, of which he is the chairman. This is an international project, and is actually the joint effort of three nations and seven great oil companies, who will now share on agreed terms the wealth accruing from the enormous output of oil anticipated after first paying the Iraq Government 4/– on every ton of oil produced.

A typical example of the floods that seriously hampered work.

Before the present operations commenced, a vast amount of surveying had been done by expeditions sent out in 1928, 1929 and 1930, to determine, after many proposals and modifications, the route for the new pipeline. Its "fountain head" is at Kirkuk, in the region referred to in the Book of Daniel with its "eternal fires," which doubtless were none other than natural gas seepages indicating the hidden reserve of oil. When test drills were made in 10 areas in 1927 it was here that the most important gusher was discovered; and over the surrounding area of approximately 50 square miles more than 30 wells have been drilled, every one of which gives an abundant yield of oil.

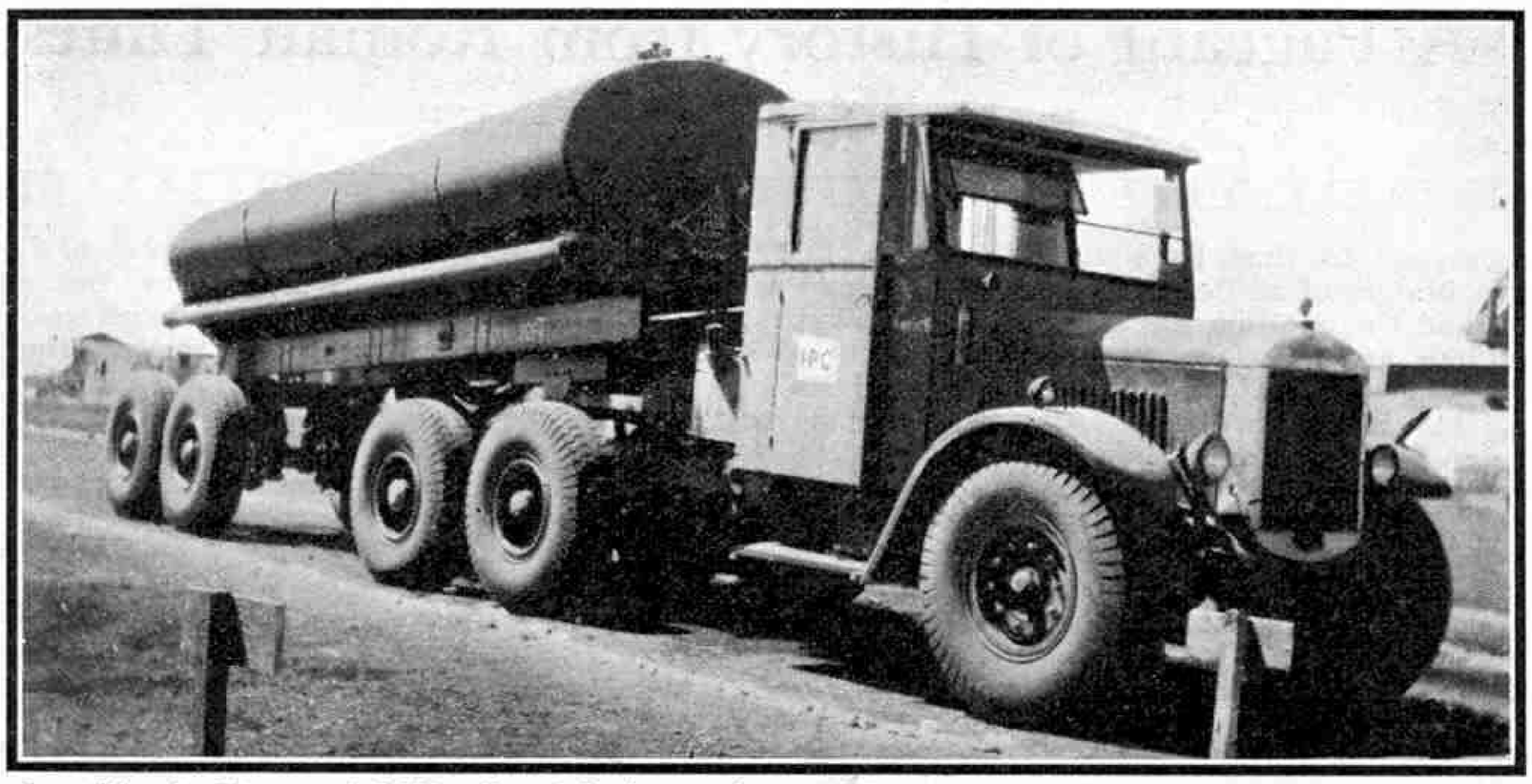
From Kirkuk the pipeline has been laid in duplicate to Haditha, which is 150 miles south-west on the Euphrates. Thence it divides, one line running 381 miles east to Tripoli through Syria, which is French mandated territory, and the other 470 miles to Haifa, through British mandated territory. It is believed that the pipeline will greatly increase the importance of these towns, and large areas of land near them have been set aside for the provision of storage accommodation and for the eventual construction of receiving and refining plants. Under an agreement concluded in 1931 the Iraq Petroleum Company was pledged to complete its task of laying the pipeline by the end of 1935.

Pipe-laying gang at work near Orontes Crossing, Iraq. For the photographs on this page, and the lower one opposite, we are indebted to the Iraq Petroleum Company.

Some idea of the gigantic task involved may be gained when it is learned that the main pipeline is of 12 in. interior diameter, representing approximately 118,000 tons of pipe. Of this total 45,000 tons has been supplied by British firms, and the balance by American, French and German manufacturers. In order to overcome any difficulties that might arise through the extreme climatic temperatures prevailing in that part of the world, the line has been buried throughout its entire length, necessitating an extensive equipment of trenching and other machines. All the joints in the entire line were electrically welded, and after cleaning by special machines the line was coated with asphaltic preservative protected by a spirally-wound wrapping of asbestos felt, and covered with

a coat of hard-setting bituminous enamel.

The transport of the pipes, plant and supplies incidental to such a project was a gigantic undertaking through territory that is almost entirely desert or waste. There are extensive areas where limestone outcrops abundantly, while the surface varies from 500 ft. below to 3,000 ft. above sea level. Various types of heavy-duty six-wheeled motor lorries were employed, and on them fell the onus of transport in a country wholly devoid of roads or railways. A special difficulty presented itself in the transport of materials in the vicinity of the Tigris and Euphrates rivers, owing to the great variation in the volume of water in these streams, and the swift current when they are in flood. No greater opportunity for motor transport to prove its worth has occurred since the War, and it is scarcely any exaggeration to say that this world's biggest job could not have been undertaken without motor transport. The cost of railways adequate for the purpose would have been quite prohibitive.



One of the nine Thornycroft 2,500-gall. tank lorries used in connection with the construction of the line. Photograph by courtesy of John I. Thornycroft and Co. Ltd.

Two aeroplanes, an Avro M monoplane and a D.H.50 were acquired from Imperial Airways, who maintained the machines and supplied the pilots. These aeroplanes were found particularly useful in enabling field managers to carry out their duties, which involved the superintending of the large fleets of land motor vehicles. They proved very valuable also in carrying out survey work.

The welding and laying of this great pipe was completed in November last. In the Jordan Valley the line is about 850 ft. below sea level, and it crosses the mountain plateau of Transjordania at an altitude of 2,300 ft. The pressure of the oil will be maintained by means of 12 pumping stations along the line. Work on the erection of these stations is now proceeding, and the necessary preparations are in progress for the loading of oil tankers at Haifa and Tripoli. It is expected that the oil will start to come through the line to Tripoli next autumn, and to Haifa next winter.

A section of the pipe, treated as described in the article, and ready for lowering.

Within a year or two Iraq will become one of the world's largest producers of oil, and it is impossible to foretell what important changes this may bring about in an age when oil is rapidly becoming the world's leading source of power. The output capacity of the Iraq pipeline will be 4,000,000 tons annually. The possibilities of the country are immeasurably greater than this, however, for oil is known to exist in other areas that are not yet within the present scheme of development.

The idea of conveying oil direct from the wells to distribution depots situated many miles away originated in the early days of the oil industry. In Pennsylvania, U.S.A., where the first oil field was established, the oil was originally loaded into barrels and the greater portion of the output was distributed by road. The teamsters charged exorbitant prices for this haulage, for they were well aware that, apart from a few roundabout waterways, there was no other means by which the well owners could export their products. Later, as railways developed, huge conical wooden vats were used to convey the oil in bulk from field storage to refinery, but this practice also was very costly, and eventually pipelines were instituted.

The distinction of being the first pipeline laid down for conveying oil is claimed by two early enterprises. One of these is a pipe 2 in. in diameter and three miles in length that was laid in 1863 from the Warren Refinery to Warren's Landing on the Alleghany river, U.S.A. The other line was five miles long, and was laid down by a man named Van Syckle from Miller's Farm to Pithole City, during the period when the latter was an important centre of the oil industry. It is said that Van Syckle got his idea from noticing how successfully water could be conveyed great distances by means of iron pipes. His proposal to construct a five-mile pipeline was ridiculed by the teamsters, but he persevered with his efforts, and eventually the line was laid and proved quite successful. The adoption of pipelines by America was followed by other countries, and there are now several important lines in the oilfields of the East.

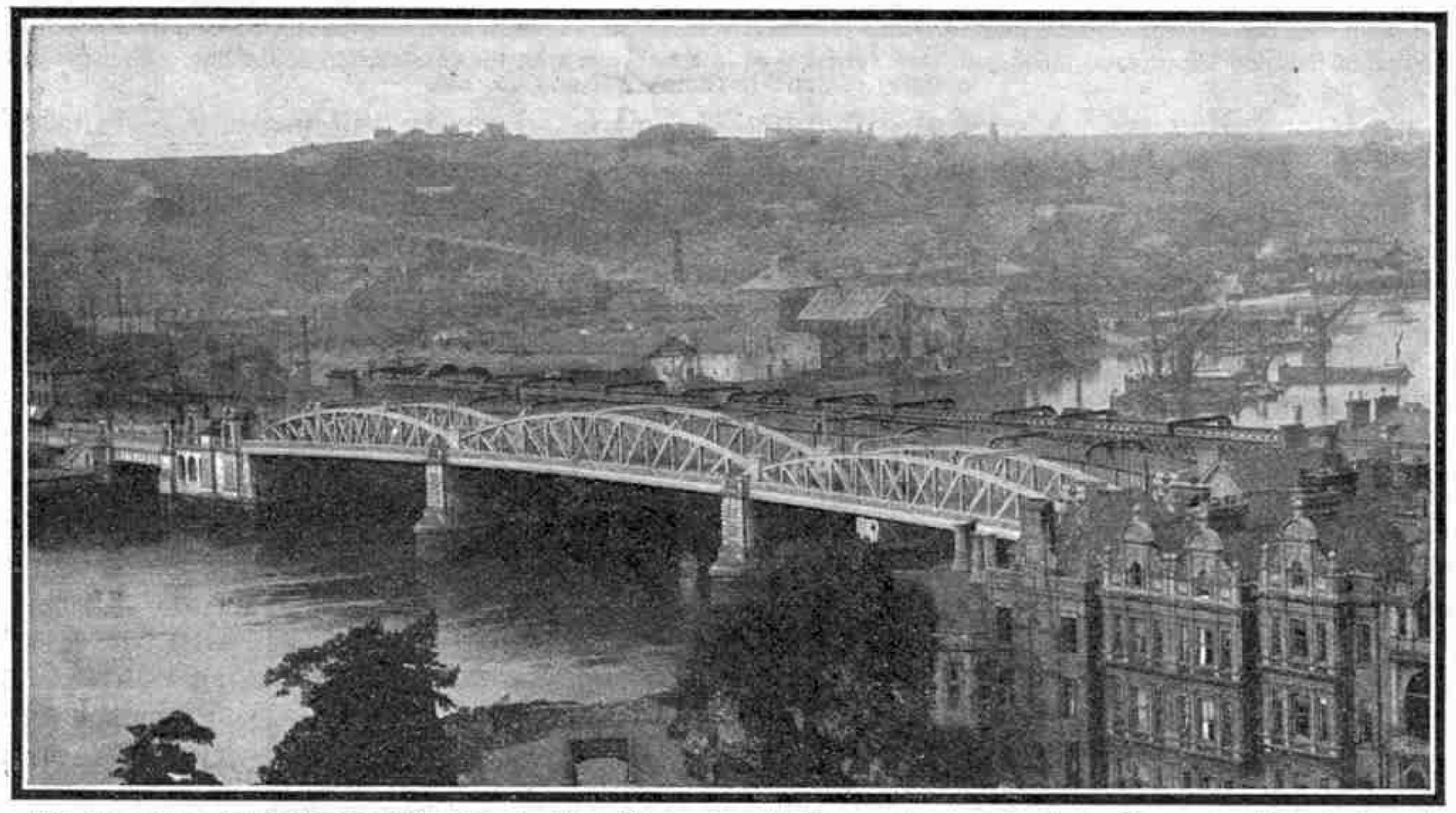
Rochester's Famous Bridges

A Pageant of History from Roman Times

By W. Coles Finch, M.Inst.C.E.

IN these pages from time to time have appeared wonderful pictures of modern bridges of all descriptions, works of great engineering skill; and the question has been asked: "What were our first bridges like, and by whom were they built?"

There were timber bridges of crude construction spanning our rivers at the time of the Roman invasion. After the Romans landed they built the ancient British road now known as Watling Street, and constructed their military way upon it. When the legions arrived at the Thames they found that the bridge between Belius' Tower and the southern bank of the river was broken down, and they were compelled to cross it at the nearest fordable point. There are certainly grounds for concluding that there was at least one bridge over the Thames previous to Cæsar's invasion of Britain. In addition, the fact that the Britons, in the attempt to prevent Cæsar's army from crossing the Thames, drove wooden piles into the bed of the river, shows that they understood timber bridge construction.



The fine lattice girder road bridge at Rochester. The railway bridge can be seen in the background. This photograph was taken from the top of Rochester Castle.

Next to Old London Bridge, the old bridge spanning the Medway at Rochester had the most exciting and interesting history, and witnessed the most stirring times. The exact date of the construction of this timber bridge is not known, but there are reliable records pointing to the fact that it was built in the reign of Edgar the Peaceable, 958-975 A.D. It lasted, after undergoing many vicissitudes from frost and flame, storm and flood, until towards the end of the 14th century.

It is probable that before this first known bridge, as standing in the year 960, there were other crude bridges to accommodate the traders with foreign lands; and it has been suggested that this old bridge may have been constructed on the piers of a destroyed structure built by the Romans, a practice that was common in England.

The first mention of this bridge is in Stow's *"Annals,"* where we read: "When King John, A.D. 1215, besieged and took Rochester Castle, he attempted also to burn the bridge, but that Robert Fitzwalter put out the fire and saved it. . . . . The bridge was of wood, having a wooden tower upon it. It was very strong, being built with nine arches (piers ?). In A.D. 1264 the Earl of Leicester burnt the wooden tower and a good part of the bridge when he engaged himself in the Barons' Wars against King Henry III." In reference to this episode it is recorded: "Having made several fruitless attempts to carry the bridge, De Montfort hit upon an entirely novel device. Several small ships were filled with inflammable matter; their decks were heaped high with dry wood; covered with pitch, sulphur and pork fat. These vessels were set on fire and floated against the bridge, which quickly caught fire."

We also learn from Stow's *"Annals"* that in 1281 a very severe and prolonged frost occurred, the river being entirely frozen over, so that people went across on foot. On a sudden thaw coming, the ice, breaking all at once, carried away with the stream almost all the remains of this old bridge. In a similar manner were swept away five arches of London Bridge, and the same catastrophe befell many other bridges in England.

The bridge remained in a ruinous condition for a long time after the disaster, and Harris, the historian, described it 12 years after the frost as so broken down and out of repair that people were obliged to cross the river in boats. That it was a dangerous structure is certain. In February, 1300, Edward I was in the city, and he hired a horse of one, Richard Lombard. In crossing the bridge the horse was blown into the Medway and drowned, and Lombard received twelve shillings from the King to recompense him for his loss.

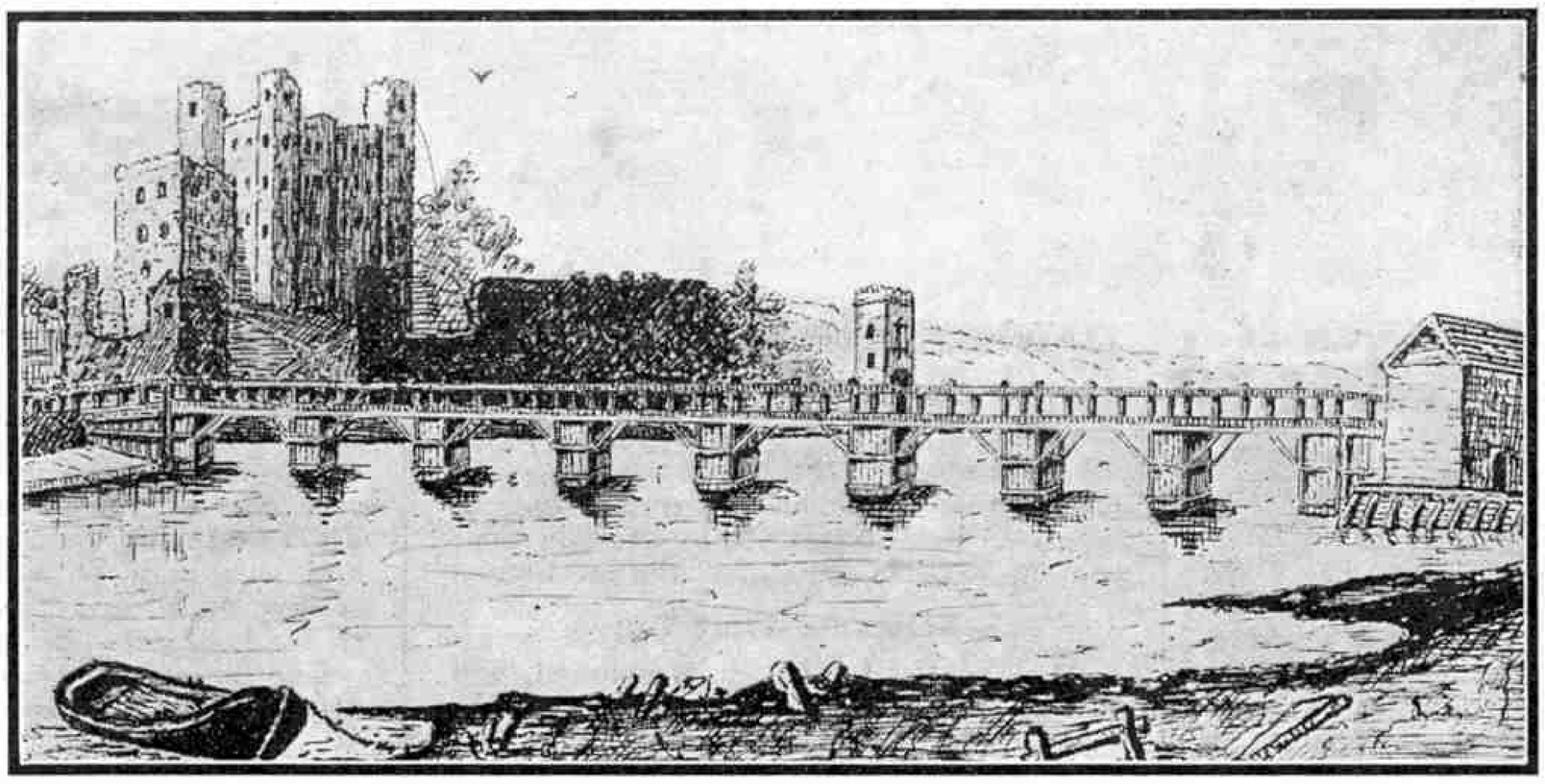
In the 17th year of King Edward III certain lands and townships were made responsible for the repair of certain piers, and the King was to make the barbican and the draw-bridge. Notwithstanding all this care, after the taking of Calais, the bridge was found to be so continuously subject to repair, because of the continual fretting of the salt water and the working of the tides, and the mighty concourse of travellers to and from France, all of whom must pass over the bridge, that it became dangerous for horses and carriages to cross it. We are told that: "Proper repairs were much neglected, and the structure seems to have remained in a ruinous condition until about 1344-5, when a safe passage was made for men and horses and a draw-bridge and barbican were added to the west side. In less than three years the traffic became so great that the wooden bridge appeared unsafe. Some 40 years, however, passed away before commencing the stone bridge."

This fine "late decorated" bridge of 10 arches with a carriage-way of 15 ft., was commenced in 1387 and completed in 1392 at the charge of Sir Robert Knolles and Sir John de Cobham, and it served for some 470 years.

In reference to this bridge we are on surer ground than in the case of its wooden predecessor for its history has been fully recorded. In 1386 Lord Cobham built the Chapel of Allsoven (All Souls) at the Rochester end, the ruins of which still remain. It was built for the use of travellers and pilgrims. Three chaplains were appointed at a salary of six pounds each per year, and there were three services each day, prayers being offered for the living and dead benefactors of the bridge and the chapel, and for the souls of the founder and his lady. At the Strood end of the bridge was another chapel dedicated to St. Mary. This served a similar pious service, but has long since disappeared.

In 1445 the bridge became so dilapidated that the Priory of St. Andrew, Rochester, abandoned a claim of forty shillings, part of the bridge toll due to the Priory, in order that it might be repaired. In 1449 its condition was so grave that the Archbishop offered a remission of forty days from purgatory for divers sins to all persons who would contribute to its repair. In 1557 certain tolls were levied for the use of carriage-way and water-way, and subsequently the financial affairs of the bridge were placed on a sound basis, the details of which we have not here space to tell.

When first built, the bridge had only a dwarf parapet for protection, but some 20 years later Archbishop Warham provided a protective iron railing. We may note in passing the remarks, written in 1772, of the French Ambassador regarding the bridge: "The country is beautiful, especially near the large village of Rochester, which is chiefly deservable on account of its bridge, furnished with high iron railings, that drunkards, not uncommon here, may not mix water with their wine." Later a stone balustrade was added, a portion of which may now be seen on the Esplanade river front, where it offers a similar protection to the public.



The timber bridge that spanned the River Medway at Rochester nearly 1,000 years ago. It is said to have been built in the reign of Edgar the Peaceable, 958-975 A.D., and lasted until 1387.

The Lollards marched over this bridge in 1414, as did Jack Cade in 1450; and the troops to and from the Continent in the Hundred Years' War likewise used it. The unfortunate expedition under Sir Thomas Wyatt crossed over it, and also the parties of the Civil War, when Royalist and Roundhead fought for its passage in 1640. These references will suffice to show the exciting events that the bridge witnessed.

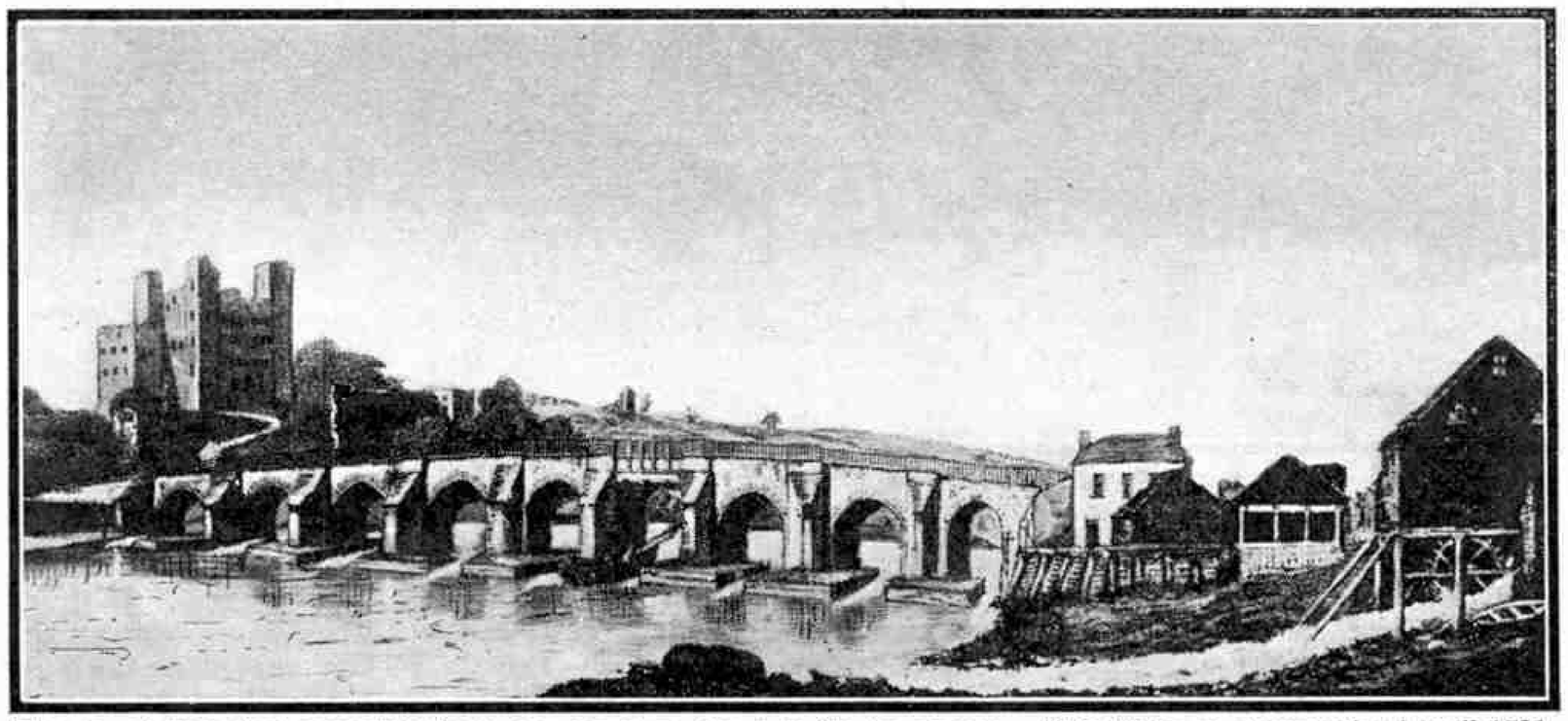
In more peaceful procession there passed over this bridge the motley stream of pilgrims bound for Canterbury. The poor travelled on foot, the well-to-do, as with the pilgrims of Chaucer fame, rode on horseback. Horses could be hired at Southwark for the journey to Rochester for twelve pence, and a relay from Rochester to Canterbury for a similar sum.

The starlings, or groups of piles upon which the piers of the bridge were built, were very large and greatly hindered the flow of the tide. This obstruction caused large shoals to be formed, and these seriously interfered with the berthing of large shipsoff Rochester, and also affected the Naval Dockyard at Chatham. The gradual increase in the size of the ships using the river, and the increasing importance of the Dockyard, made the removal of these shoals increasingly important, and considerable sums were expended on this work. In 1818 the Commissioners of the Navy expressed the opinion that nothing short of demolishing the bridge would get rid of the shoals, and although the two centre arches were merged into one in 1822, there was very little improvement in the situation.

During the period 1814 to 1824 the Government spent over £23,000 in removing shoals caused by the bridge. As might be expected, there was a great deal of correspondence on the subject between the Admiralty and the Wardens of the bridge, and eventually the Wardens realised that the only solution to the trouble was the construction of a new bridge on better principles. In 1829 they requested the engineers Smirke, Rennie and Mylne to survey the bridge and report upon its condition; and also to estimate the probable annual cost of keeping the bridge in temporary repair until a better one could be constructed. The engineers made a long report in which they expressed the opinion that the bridge could be maintained in a safe condition for a further 20 or 30 years, and suggested that the Wardens should set aside their funds, then about £9,000, for defraying the cost of future important repairs caused by the ravage of the starlings.

On 14th May, 1846, a Bill was passed by Parliament authorising the Wardens to erect a new bridge on condition that provision was made for part of the structure to be opened when required for the passage of large ships. The building of the new bridge was begun four years later and was completed in 1856. This bridge was designed by Sir William Cubitt and was built on the site of the Roman bridge, the work being carried out under the supervision of the resident engineer. Operations were commenced on the Strood side of the river, where the first pile was driven on 16th April, 1850. The piles consisted of cast iron hollow cylinders that were sunk through the river bed until they rested upon rock, sinking being effected by closing the tops of the cylinders and injecting air at a pressure greater than that of the atmosphere. When a cylinder rested on the river bed and had been pumped dry, workmen descended and excavated the soft earth until the cylinder rested firmly on a rock base. The sunken cylinders or piles were then filled with concrete and brickwork and bound together by cast iron sideplates and covering plates. The masonry of the piers and abutments was then built upon these piles.

The structure consisted of a main bridge that extended the greater part of the distance across the river and was succeeded at the west end by a swing bridge erected for the benefit of ships that were too large to pass beneath the fixed bridge. The main bridge was about 485 ft. long and 40 ft. wide, and had three arches, two of 140 ft. span and a centre arch of 170 ft. span. Each arch consisted of eight main ribs, those of the centre arch being cast in six pieces and those of the side arches in five. The ends of these numerous castings were planed by special machinery, and when assembled on the site the pieces were fastened together by strong iron bolts. The ribs were firmly braced together with cast iron frames fitted at intervals between them. The roadway and footpaths were carried by cast iron plates that were bolted to the tops of the spandrils of the arches and made water-tight with iron and cement. These covering plates were overlaid with planking, and this in turn was covered with a layer of granite pitching. A heavy and handsomely moulded cast iron cornice and parapet railings completed the bridge above the road level.



The stone bridge that succeeded the timber structure shown in the top picture. This bridge as shown existed until 1781 and in slightly altered form until 1856.

The swing bridge consisted of six wrought iron girders carried by and turning upon a cast iron roller path 30 ft. in diameter, and it was so perfectly balanced that only a small force was required to open or close it. When open the bridge gave a clear passage 50 ft. in width to shipping.

The entire structure included 2,500 tons of cast iron, and, with the approaches, cost £160,000. The bridge was opened to the public on 17th August, 1856, and the day was observed as a general holiday. A procession headed (*Continued on page 248*)

Aeroplanes in the Wilds

In these days of long-distance air travel, deserts are losing their solitude and the jungle its terrors. An interesting example of this was given a short time ago when an Imperial Airways liner flying between Baghdad and the Gulf of Suez made a landing about 60 miles from Rutbah Wells in order to enable the pilot to make a small adjustment. The scene where the air liner landed was one of such loneliness and solitude that the pilot remarked to his passengers: "Here you have the real desert."

He had hardly said this, however, when aeroplanes and motor cars began to appear as though from nowhere. Several R.A.F. machines came soaring overhead, and on ascertaining that all was well, entertained the passengers of the air liner with an impromptu display of flying. Then several motor cars arrived, and after that another aeroplane that was engaged in patrolling the Iraq Pipe Line. The pilot of this machine alighted to see if he could be of assistance, and some passengers he had with him joined the throng. Finally a couple of motor cars driven by natives were seen approaching, but they did not stop, their occupants merely glancing across and passing on as though the sight was of too everyday a character to merit special attention.

Another interesting account is contained in a report from a small party of engineers who were flying from one part of Africa to another in a machine required to supplement a service. While they were in the air they were advised by radio to alight in order to avoid a storm just ahead, and they came down at a jungle halt hundreds of miles from anywhere. There was not a sign of life as they alighted; but hardly had they emerged from their cabin when a friendly native appeared, and obligingly clambered up a tree to fix the aerial enabling them, while on the ground, to keep in wireless touch with stations on the route. A big game hunter then came on the scene, and, as his camp was not far off, insisted on their coming back and joining him at lunch!

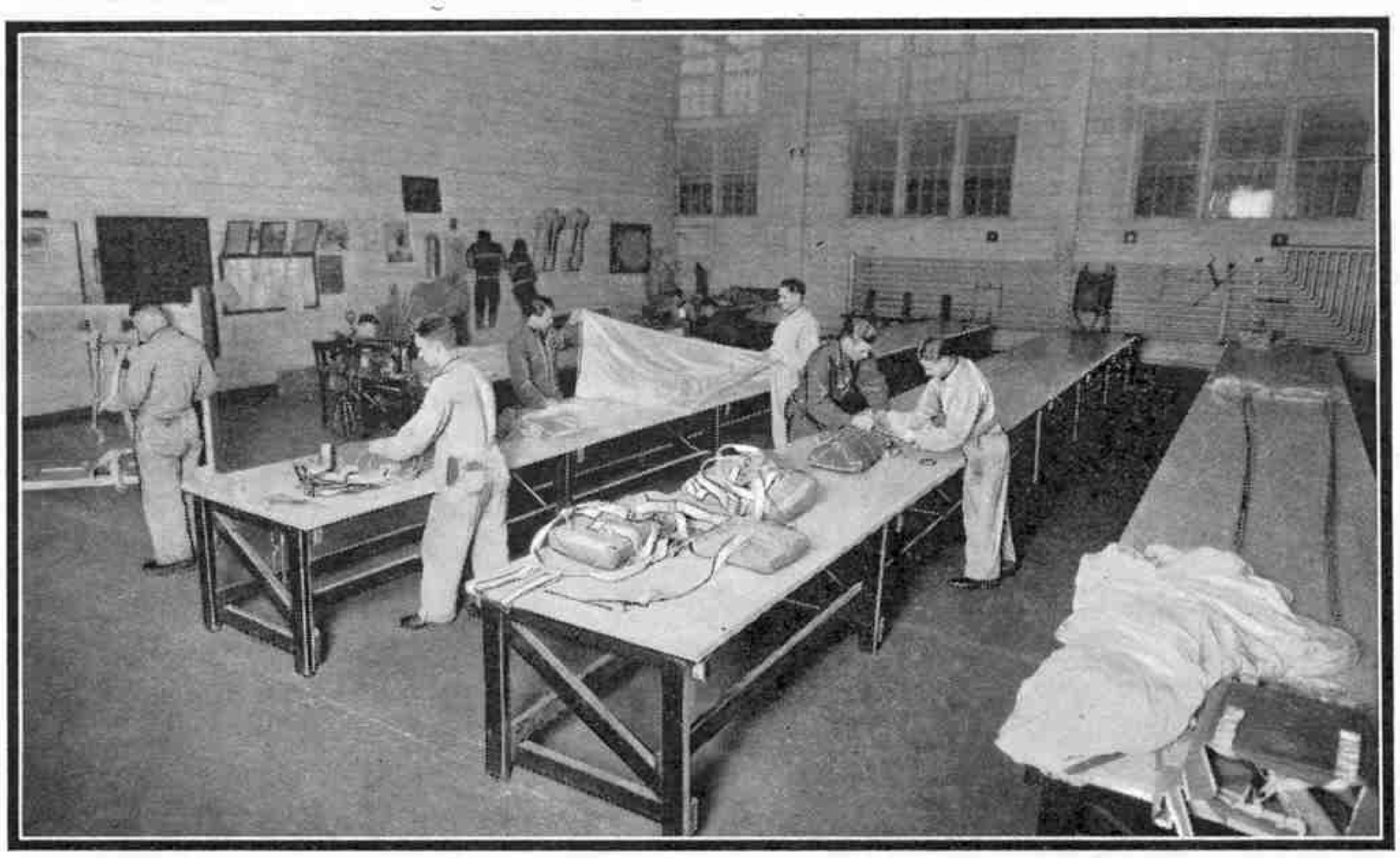
Rotors for Wing Tips

An invention which, it is claimed, will enable a normal fixed-wing aeroplane to land steeply and slowly like an "Autogiro," has been developed by a British inventor, Dr. A. B. Thurston, and has successfully passed tests carried out by the National Physical Laboratory and the Royal Aircraft Establishment at Farnborough. The invention is called the Thurston Rotor, and it consists of a small double-bladed rotor mounted at the tip of the leading edge of the wing, one rotor being fixed on each side of the aeroplane. The rotor is about a quarter of the span of the wing in length, and measures 1/6th of its own length in width. It is not connected to the engine, but is able to spin freely on a vertical spindle in a similar manner to a child's paper windmill. It will be realised that the rotor turns very rapidly when the aeroplane is moving through the air at flying speed.

The rotor normally fits snug along the leading edge of the plane, but the spindle on which it is secured may be raised by the pilot to bring the rotor into action. The inclination of the spindle can be varied as desired, increasing or decreasing the lifting effect as the case may be. A great deal of additional lift should be gained in this manner, and this may be used in reducing the stalling speed and allowing the aeroplane to land almost vertically.

The inventor claims that a machine fitted with his rotors is able to descend at an angle 34 per cent. steeper than if not provided with them, and 30 per cent. steeper than if fitted with Handley-Page automatic slots. A feature of the descent of a rotor-fitted aeroplane is that the nose can be kept well down, thus giving the pilot a good view; whereas in a slotted aeroplane the nose has to be kept well above the horizon when landing with the aid of the slots.

No really satisfactory method of stowing the rotors while the machine is in the air has yet been evolved, but this is a mechanical difficulty that should soon be cleared away. In any case tests with models show that when the rotors are fitted snug along the leading edge before the machine takes off, they will automatically come into operation as soon as the normal stalling angle is reached.



Packing parachutes in the United States Army Air Corps. The practice dummy figures on the wall should be noted. Official photograph, U.S. Army Air Corps.

Light Aeroplane Speed Record

The world's speed record for light aeroplanes of unlimited engine size and aeroplane weight has been gained by a French airman, M. Massotte, who covered a distance of 1,000 km., approximately 620 miles, at an average speed of 225 m.p.h., in a Caudron C.362 monoplane fitted with a Règnier six-cylinder-in-line air-cooled engine. The record was set up at Istres, Marseilles and exceeds by 10 m.p.h. the previous one held by a German pilot and a Heinkel machine. A feature is that the engine in the German machine developed 638 h.p., whereas the French engine was only rated at 200 h.p.

New Series H-Type Engine

The Napier "Rapier" series II and IV engines have now both passed the hundred hours' type test required by the Air Ministry. These engines are of the 16 cylinder air-cooled "H" type, the cylinders being arranged in four banks each consisting of four cylinders in line. The series II "Rapier" is rated at 305 h.p. at 3,500 r.p.m. and 10,000 ft., while the IV is rated at 340 h.p. at 13,500 r.p.m. and sea level.

An interesting feature of the "Rapier" is that two crankshafts are employed, geared together, to drive the airscrew shaft. This gives the engine a very small frontal area, which is extremely important in modern streamlined machines, particularly those intended for fighting purposes. In the preliminary models of the engine difficulty was experienced in the cooling, but this has been overcome in the Mark II and IV engines by employing baffle plates that direct air streams on to the cylinders, keeping them at a practically constant temperature. We hope soon to publish a fully illustrated article on this engine.

London-Paris Flights Without Passports

As a result of a decision that has been reached by the British and French authorities, passports will no longer be required by air passengers making week-end trips between London and Paris. This new facility will be appreciated very greatly by air travellers, and it ought to have a considerable effect, particularly during the summer months, in stimulating aerial travel between the two countries.

Imperial Airways are now making final arrangements for regular non-passport air trips between London and Paris. In future week-end tickets and reduced rates will be available, enabling passengers to leave London or Paris on a Friday and to return at any time up to the following Tuesday.

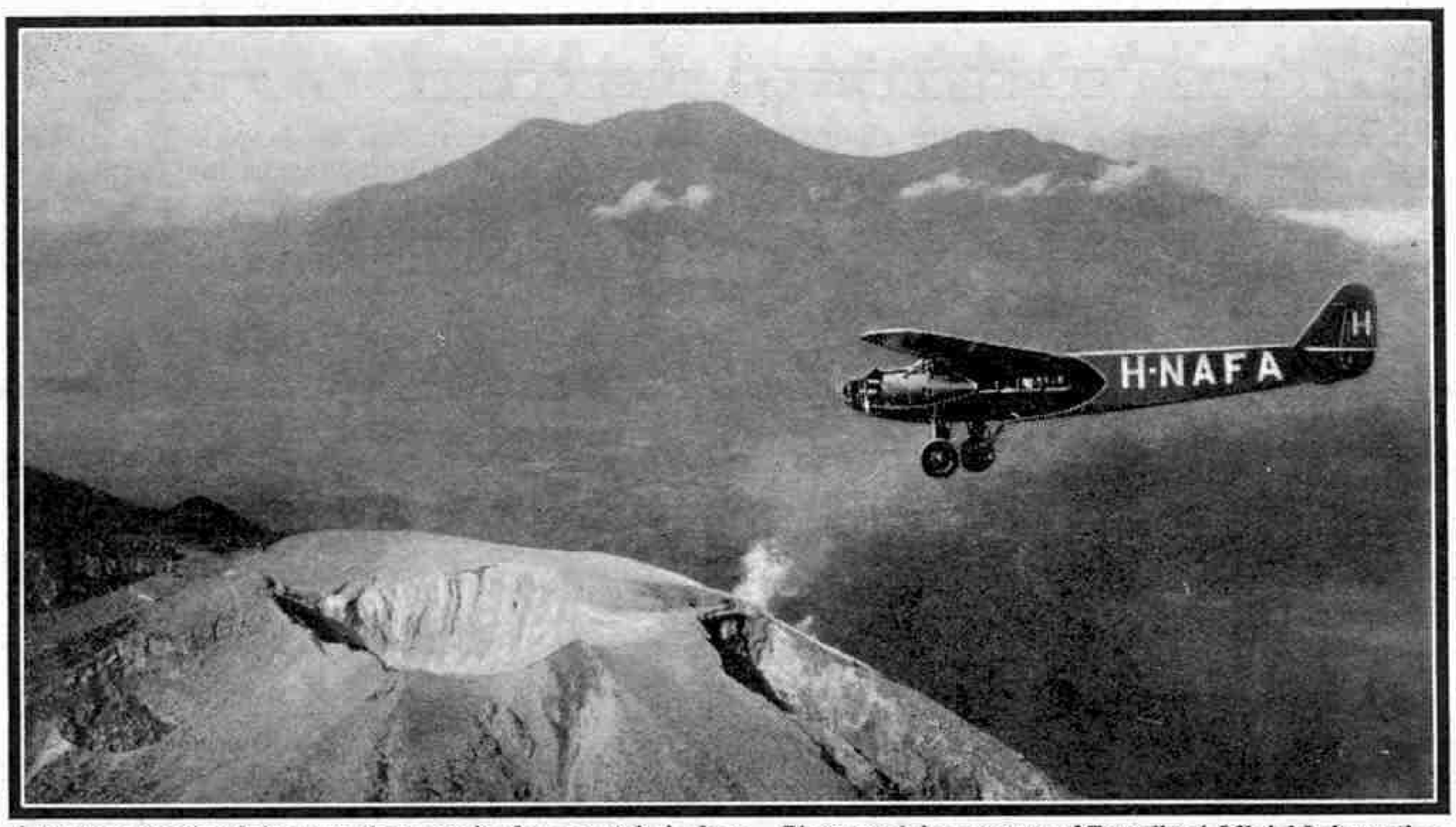
French Flying Boat Crosses the Atlantic

A non-stop flight across the Atlantic has been made by a French Latécoère flying boat, the "*Croix du Sud*," which flew from France to St. Louis, Senegal, and from there non-stop to Natal. This machine was designed specially to operate a regular air mail service across the Atlantic, and is equipped with four Hispano-Suiza engines which develop a total horse power of about 2,600.

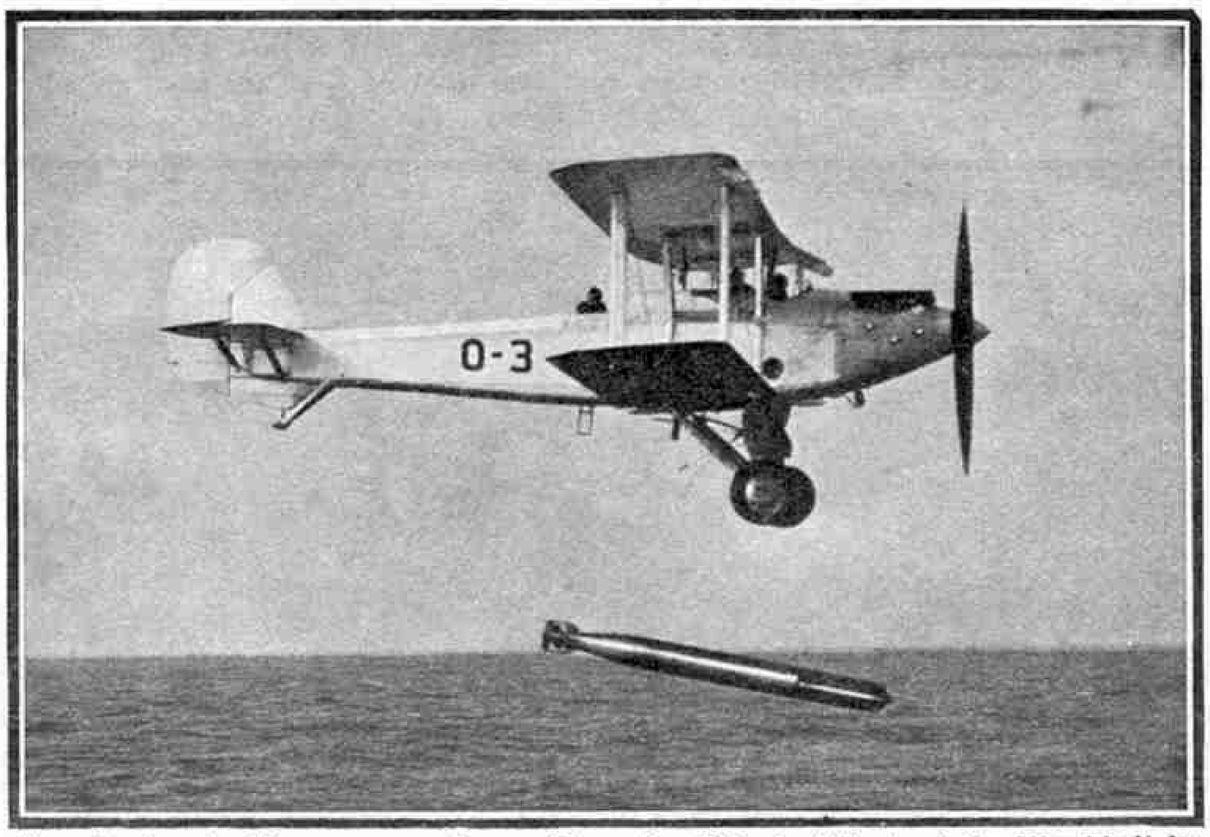
New Continental Air Services

A new Italian air service between Marseilles and Rome is now in regular operation. It is carried out by aeroplanes of the Società Italiana Servizi Aerei, the journey taking about three hours. The service makes it possible to leave London in the morning by an Imperial Airways machine and, by joining up with other services, to arrive in Rome the same evening. Malta may then be reached at about 1 p.m. on the following day, making a total time of one-and-a-half days. This saves a full day over any other method of transport, while in the summer it will probably be possible to travel between London and Malta in less than twenty-four hours.

Another new service is between Stockholm and Leningrad by way of Esthonia and Finland. This service is operated by the Swedish A.B. Aerotransport, the Finnish Aerop O/Y, and the German Deruluft Company. The section of the flight between Leningrad and Tallin is carried out by landplanes of the Deruluft Company, while the Tallin-Stockholm stretch is flown by seaplanes of the Swedish and Finnish companies.



A Fokker machine flying over the summit of a mountain in Java. Photograph by courtesy of Travellers' Official Information Bureau, Weltevreden, Batavia, Java.



Torpedo dropping from an aeroplane. (From the Editor's "Book of the Warship," by courtesy of the publishers, G. G. Harrap and Co. Ltd.)

A Turbine Engine for Stratosphere Flying

Two Dublin engineers are stated to be at work on a special new type of aero engine of the impulse turbine type that will be specially suitable for aeroplanes intended to fly in the stratosphere. The engine will be operated by hydrogen carried in the aeroplane in liquid form. It is proposed at first to cool the engine by air although a different method may be adopted later. The greatest difficulty so far experienced is that of silencing sufficiently the hydrogen explosions.

Experimental engines have already been built, and a working model that is shortly to be constructed is expected to prove that the engine will be capable of developing a sufficient number of revolutions to enable it to drive the airscrew without gearing, even in the rarefied air in the stratosphere. When the engine is installed in an aeroplane, however, a variable pitch airscrew will be employed, to enable the maximum efficiency to be extracted from the engine at all altitudes.

New Form of Blackburn "Segrave"

On page 221 of the "*M.M.*" for March, 1931, we published an illustrated description of the Segrave "Meteor," and on page 795 of the October issue of the same year we dealt with the all-metal modification of the type. The machine has now appeared in another form, in which it is provided with a single spar wing of the cantilever type that is claimed to be exceptionally strong. The spar is a duralumin tube of circular cross section, supported internally by a number of ring formers, and externally by corrugations at the top and bottom. A special method of attaching the metal ribs to the spar has been developed, and the whole wing construction is of extreme simplicity.

An interesting feature of the machine is that part of the tubular spar is employed as a petrol tank, which makes possible a great saving in weight by rendering unnecessary separate petrol tanks and their supports. Full details of the new spar are not yet available.

Non-Stop Flight Round the World

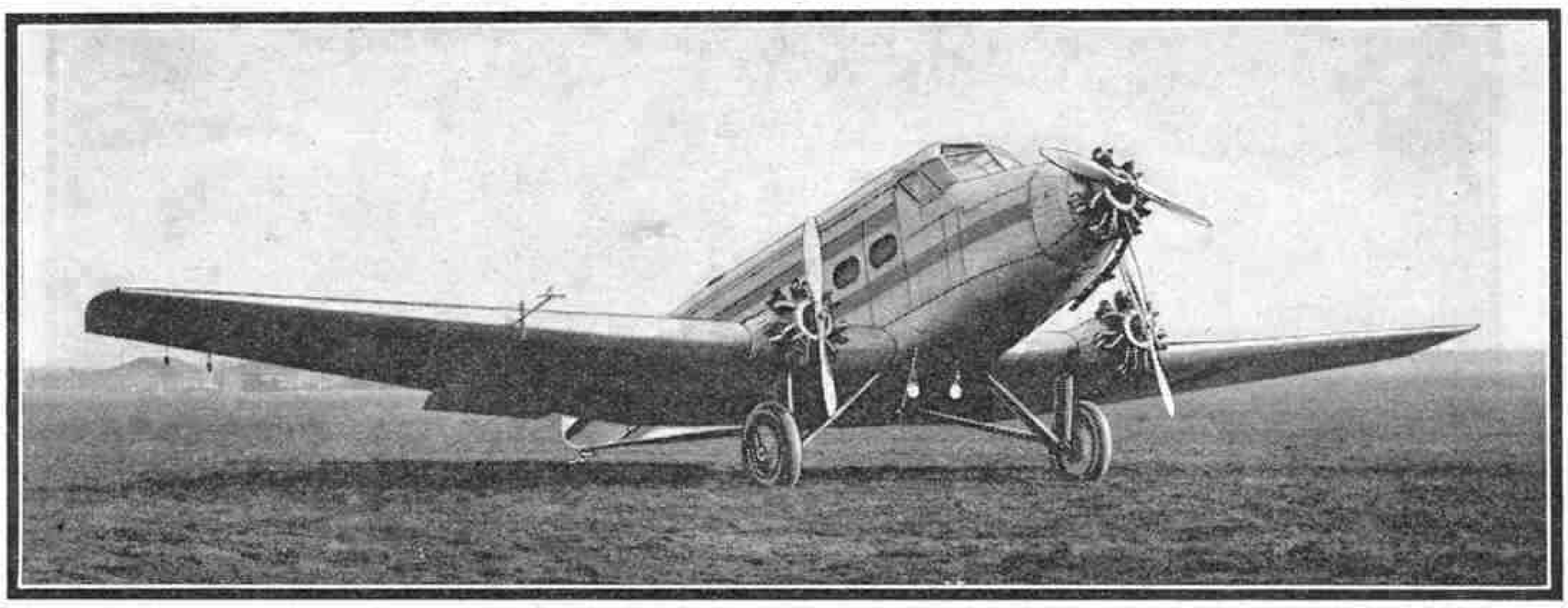
Plans are now being prepared for a non-stop flight round the world. All the refuelling would be done from another machine while in flight, and a distance of 24,000 miles would be covered.

More Interesting Foreign Aeroplanes

Some French Cabin Monoplanes

THE aeroplanes with which we deal this month are all made by French aircraft constructors, and they are all of the cabin monoplane type, one being a low wing monoplane and the other three high wing machines. They are the Farman F-190, a single-engined high-speed transport aeroplane; the Latécoère 29 torpedoplane; the Potez 36 light aeroplane, and the Wibault-Penhoët 281 triple-engined commercial low wing monoplane.

The Farman F-190, a four-seater enclosed cabin aeroplane, was designed for use on short air line services where there are not many passengers at a time. It is particularly suitable for the operator who prefers to fly small machines at short intervals rather than machines with more accommodation at long intervals. It may be employed also with great success on "feeder" lines, carrying passengers from outlying districts to aerodromes where they may link up with the regular long-distance services. The machine is a high wing monoplane of the strut-braced type, the wings being of typical Farman design having a uniform chord and section and being constructed of wood covered with fabric. A comparison of the lower photograph on this page with that of the Farman F-300 published in our January issue will show the general shape of the Farman wing. The fuselage of the F-190 is rectangular in cross section and is built up of spruce frames covered with plywood. The undercarriage is of the split type, which enables the aeroplane to land safely in long grass and on aerodromes where there are obstructions such as boulders, which would damage an ordinary axle and cause the machine to tip over while taxying.



The Wibault-Penhoët 281 monoplane, an air liner with accommodation for ten passengers. It has a maximum speed of 147.5 m.p.h. and cruises at 128 m.p.h. Photograph by courtesy of Chantiers Aéronautiques Wibault-Penhoët.

The cabin for the passengers is totally enclosed and is immediately beneath the wing. It has accommodation for five, four of whom are seated side by side in pairs, the pilot's seat being in front and immediately beneath the leading edge of the wing. The machine is equipped with one Gnôme-Rhône "Titan" air-cooled radial engine that develops 230 h.p. but if desired, any engine developing between 200 and 250 h.p. can be fitted. The petrol supply is carried in the wing, the feed to the engine being entirely by gravity. The monoplane is capable of attaining a maximum speed of 124 m.p.h., cruising at 105 m.p.h., and climbing to 1,000 m., or approximately 3,280 ft., in 6 min. 5 sec.

The F-190 is one of several types that are built by the Farman Company, and which include a huge bomber known as the "Goliath" that can be employed also for commercial purposes, when it has accommodation for 12 to 14 passengers. It can be rapidly converted for service as an ambulance machine with room for 10 passengers. In addition to the "Goliath" are several Farman two-seater light low wing monoplanes that are all very similar to each other but are fitted with different engines. It is interesting to note that one of these, the Farman F-230, is claimed to be one of the most successful two-seater light monoplanes in France. At one time it held the world's record for its class for speed, height, duration, distance in a straight line, and distance over a closed circuit. The Farman Company have produced also a single-engined monoplane specially for experimental work in the upper atmosphere. It is known as the Farman "Stratosphere," and is a two-seater provided with a special cabin that can be made into an airtight compartment when high altitudes are reached. Normal air pressure is maintained inside this compartment by means of a special compressor operated by the engine.

The upper illustration on the next page shows a version of the Latécoère 29 single-engined torpedo-carrying seaplane with a torpedo in position below the fuselage. The wings, fuselage and tail unit of this are very similar to those of the Latécoère 28-1B, details of which were given on page 26 of our issue for January of this year. The machine is a seaplane, however, although a version with a wheel undercarriage is available. The floats of the 29 seaplane are made of metal and are of the long single-step type. They are attached to the fuselage and the struts bracing the wings by means of special steel-tube struts, in such a manner that no difficulty is experienced in stowing the torpedo underneath the fuselage, or in releasing it when the machine is in flight.

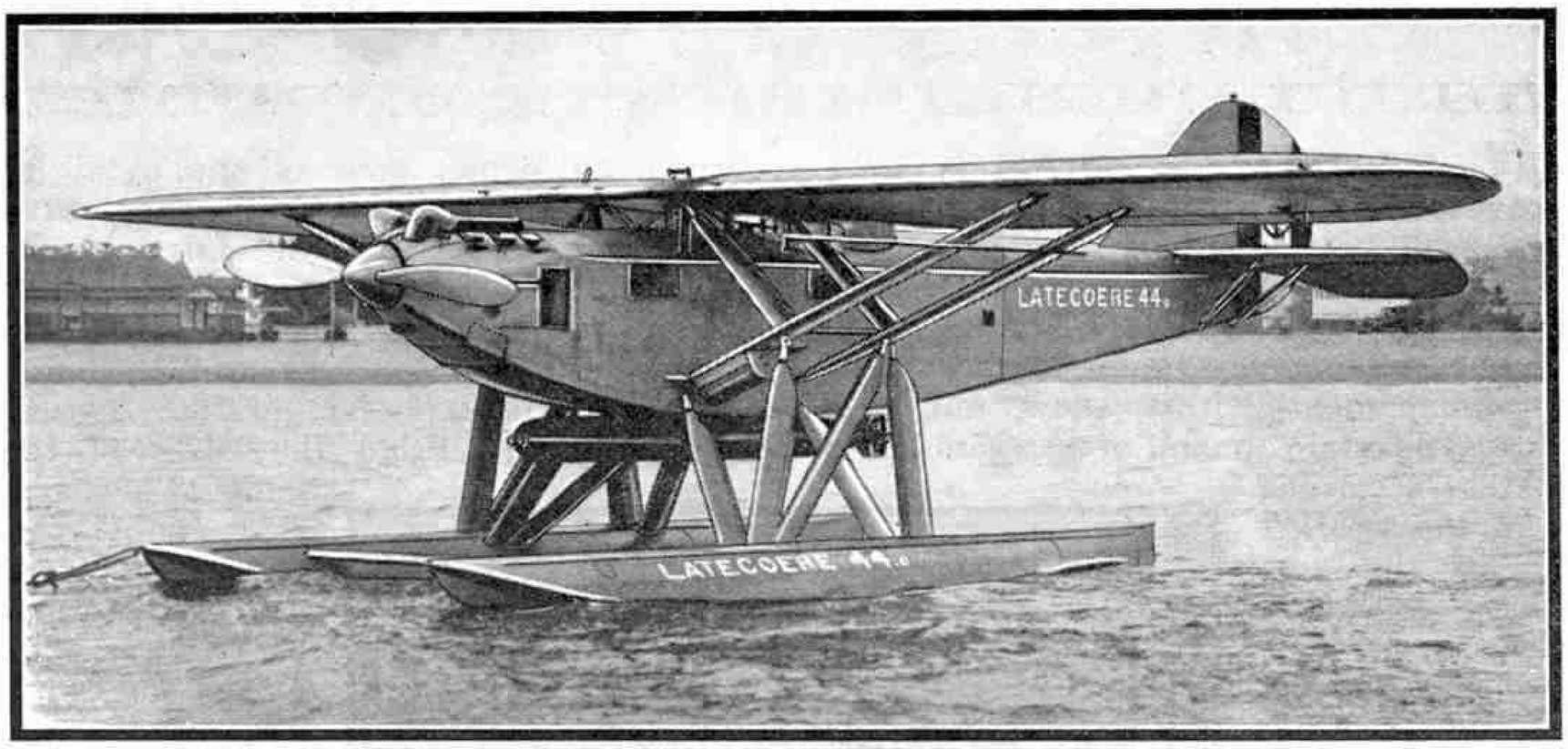
This photograph shows the Farman F-190 high-speed transport aeroplane, which has accommodation for four passengers and a pilot. Our photograph is published by courtesy of Avions Henri et Maurice Farman.

An unusual feature for a small military machine is that the two occupants are seated side by side in an enclosed cockpit. One acts as pilot and the other is concerned only with navigation and dropping the torpedo, so dual controls are not fitted. A Hispano-Suiza 12 Nbr 12-cylinder water-cooled and geared engine that develops 650 h.p. is employed. Fuel is fed to it from a tank, carried in the fuselage, that can be dropped by means of a quick release device in the cockpit when there is any danger of fire or of a crash.

With a torpedo in position the 29 is capable of maintaining a

speed of about 123.8 m.p.h. when flying at sea level, while the minimum speed that must be kept up to prevent the machine from stalling is 62.7 m.p.h.

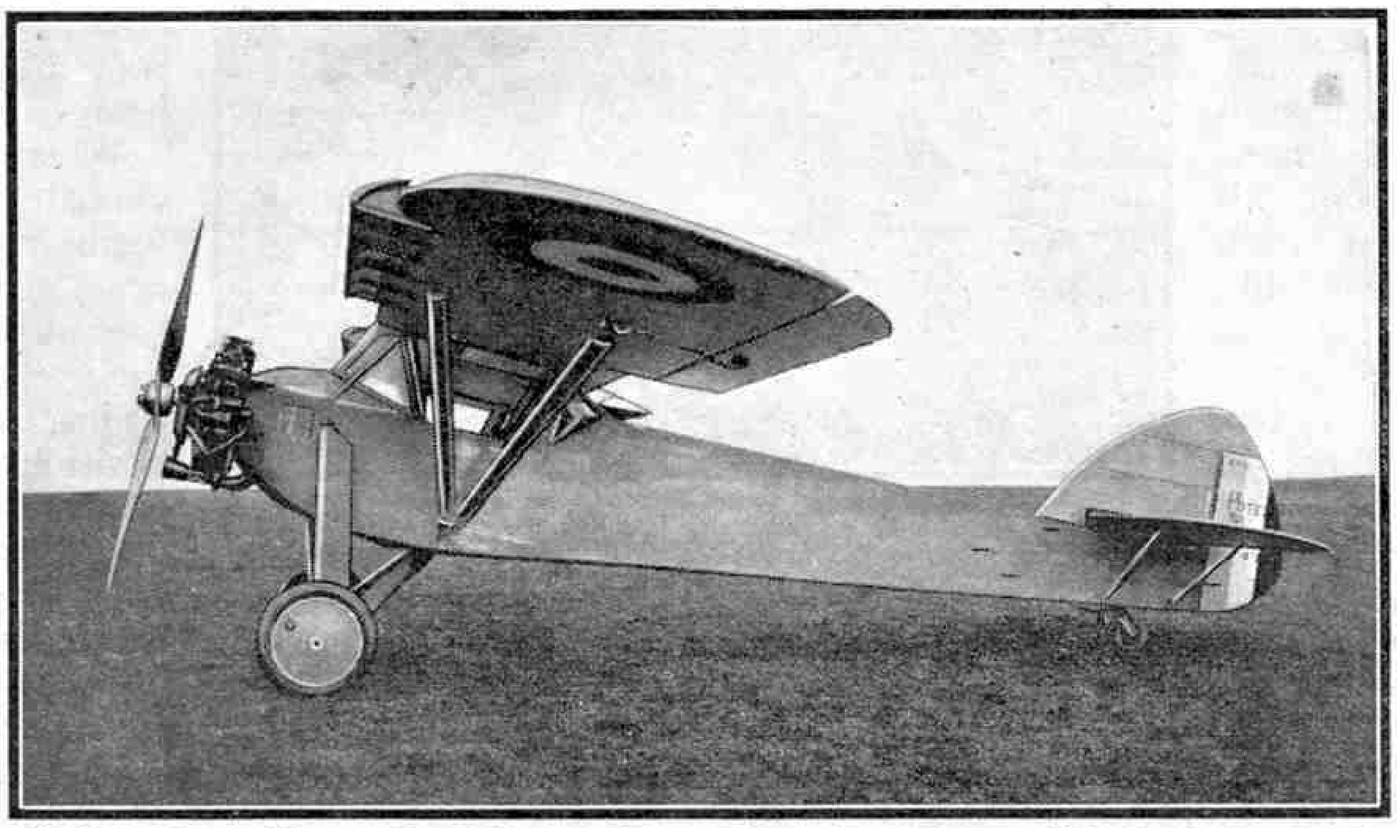
In addition to the 28 and the 29, the Latécoère Company produce a range of several machines including both landplanes and seaplanes. One of the most interesting seaplanes built by the firm is a four-engined long-range mail flying boat that has been designed specially for the carrying out of transatlantic services. This has a maximum speed of 125.4 m.p.h. and a range of 2,008 miles against a head wind of 31 m.p.h. Three other flying boats are built by the firm, one of these being intended for the transport of mails, another for the carriage of passengers, and the third for long-range military reconnaissance work.



The latest version of the Latecoere 29, a cabin torpedoplane that has a speed of nearly 124 m.p.h. The pilot and the navigator are seated side by side. Photograph by courtesy of La Société Industrielle D'Aviation Latecoère.

The Potez 36 is a two-seater light high wing monoplane of the cabin type, somewhat similar to the D.H. " Puss Moth " in external appearance. It is not a cantilever machine, the wing being braced to the bottom of the fuselage by two transverse vee struts on each side. The wing is in three sections, the centre one being built integral with the fuselage and forming the roof of the cabin. The other two sections are made of plywood covered with fabric, built round spruce spars and ribs and braced with piano wire and duralumin tubes. The ailerons are fitted along the whole length of the trailing edge of the outer sections, and if desired, Handley-Page automatic slots can be fitted along the entire leading edge of the outer sections. The fuselage is a normal rectangular structure consisting of four longerons braced vertically with duralumin tubes and diagonally with piano wire. The mounting for the engine is built entirely of metal. A normal monoplane tail unit is provided, and the undercarriage is of the divided type. The cabin is wholly enclosed and seats two side by side, access being gained through a large door on the right hand side.

The machine can be fitted with almost any engine developing about 95 h.p., and with the Salmson AC7 seven-cylinder radial engine, which is usually employed, the maximum speed is 93.15 m.p.h., the minimum speed 34.7 m.p.h., and the range in still air 310.5 miles.



The Potez 36, a well-known French light aeroplane. The very long ailerons and Handley-Page automatic slots should be noted. Photograph by courtesy of Aéroplanes Henry Potez.

An interesting light machine developed from the Potez 36 is the Potez 43. In this the fuselage has been lengthened, the undercarriage improved, and visibility from the cabin greatly increased. It is equipped with a 100 h.p. radial air-cooled engine built by the Potez Company, and is much superior to the 36. It does not replace the earlier model, however, being intended for those who require an aeroplane of slightly higher performance. Another interesting type constructed by the Potez Company is the 25. This is a reconnaissance biplane that has a maximum speed of 132 m.p.h., and it has proved very popular, more than 3,500 having been sold to various authorities in some 20 countries.

The last machine with which we are dealing in this article is the Wibault-Penhoët 281. This is a triple-engined low wing cantilever monoplane of all-metal construction that has accommodation for ten passengers. The wing is built, like that of the Potez 36, in three sections, the centre section being of parallel chord and thickness and the two outer sections tapering in chord and thickness towards the tips. Sheet duralumin is employed as a covering both on the wing and on the rectangular fuselage, which is also built in three sections, consisting of the engine, cabin and tail sections. The cabin section is provided with double walls and is not braced internally, but "T" section members are employed to cross-brace the rear section. An undercarriage of the divided type is fitted and the wheels are provided with brakes. In order to assist in manœuvring the machine when it is taxying along the ground, the tail skid can be steered from the pilot's cockpit.

Three Gnôme-Rhône " Titan Major " radial air-cooled engines are employed in the machine, each developing approximately 300 h.p. They are mounted in the normal manner, one in the nose and the other two in outboard nacelles on the wing, one on each side of the fuselage. The main fuel tanks are carried in the centre section of the wing, and are arranged so that they can be dropped quickly if desired.

This interesting aeroplane is 74 ft. 1 in. in span and has a maximum speed of 147.5 m.p.h. and a cruising speed of 128 m.p.h. It is capable of maintaining a height of about 8,800 ft. with one engine out of operation.

Chantiers Wibault-Penhoët, the firm that make the machine just described, was formed by the merger of the original Wibault Company with the Chantiers de Saint-Nazaire Penhoët. The original firm was founded by M. Michel Wibault, who studied aeronautics behind the German lines during the War. At the outbreak of War M. Michel Wibault was living at Lille when it was occupied by the German troops, but owing to the fact that he was a cripple he was not sent to prison in Germany, and he occupied his time by experimenting with model aeroplanes, even constructing a wind tunnel in an attic of the house where he was living. He succeeded in crossing the lines and getting back into French territory in 1917, and he at once proceeded to design aeroplanes. His first machine was a single-seater fighter, but it was not completed in time to be used on actual service.

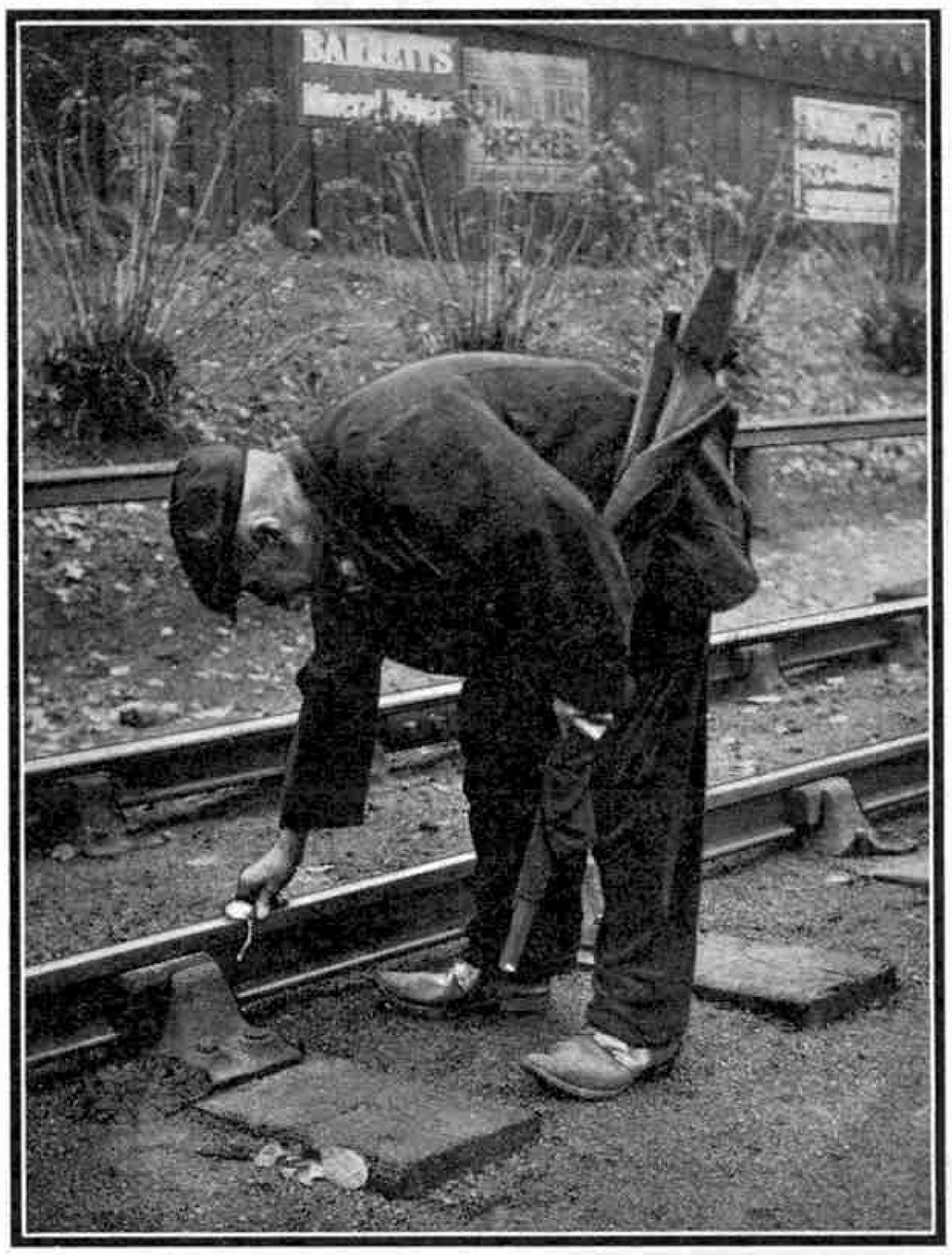
Another machine built by the Wibault firm is known as the Wibault-Penhoët 360. It is very similar to the one just described except in size, for it is only a single-engined monoplane with accommodation for four passengers. Like the 281, it is a low wing cantilever monoplane. It is powered with one Gnôme-Rhône K-7B radial air-cooled engine that gives it a speed of 152.7 m.p.h. at ground level and of 145.3 m.p.h. at an altitude of 2,000 metres, or approximately 6,600 ft.

The Railway Fogman and his Work

The Interpreter Between Signals and Drivers

THE regularity of British train services is such that we have come to take it for granted that our journeys will be finished in scheduled time, and that any connections we may have to make will be effected without the least trouble. Normally the percentage of trains arriving punctually is very high, but during the winter months frost, snow, rain and fog occasionally cause a certain amount of disorganisation that varies in extent according to the severity of the weather and the traffic in the area affected. We have previously dealt with the effects of severe rainstorms and heavy falls of snow, and with the measures taken by the railway authorities to deal with trouble from these causes. In this article we shall deal with fog, the most dreaded enemy of the railwayman.

As the safety of trains depends largely on the correct observance by the enginemen of visual signals, and on prompt action in accordance with the indications these signals display, the effect of the descent of a thick blanket of fog obviously must be serious. The driver's normal confidence in his knowledge of the road, and his expectation of a clear path for his train, are upset, and the strain of working becomes very great. A similar strain affects to a greater or less degree all other members of the railway staff connected with the operation of trains. Apart from destroying visibility, fog has the curious effect of deadening sound, and all travellers know how easy it is to mistake one's location even on a journey that is performed daily.



A fogman placing a detonator on the railhead, where it is secured by means of the soft metal clips, one of which is shown in the photograph. The illustrations to this article are by G. South, of Southport.

In this article we are not concerned with special installations such as the highly-developed G.W.R. automatic train control system, the Strowger-Hudd arrangement experimented with on the S.R., the automatic safety devices on electric railways, and the cab signalling system used on the old North Eastern main line. We are dealing only with the fogmen who are called out by the signalman and are stationed near the foot of signals along the line. It is the duty of these men to keep a sharp lookout for trains, to place the familiar detonators or fog signals on the rails to attract the attention of drivers, and to give drivers a visible indication of the state of the signals by lamp or flag. Most of us can recall a train journey under fog conditions, with the train creeping from signal to signal, none of the usual landmarks being in sight, and all noises but those of the train itself deadened, except for the intermittent explosions of the fogmen's detonators.

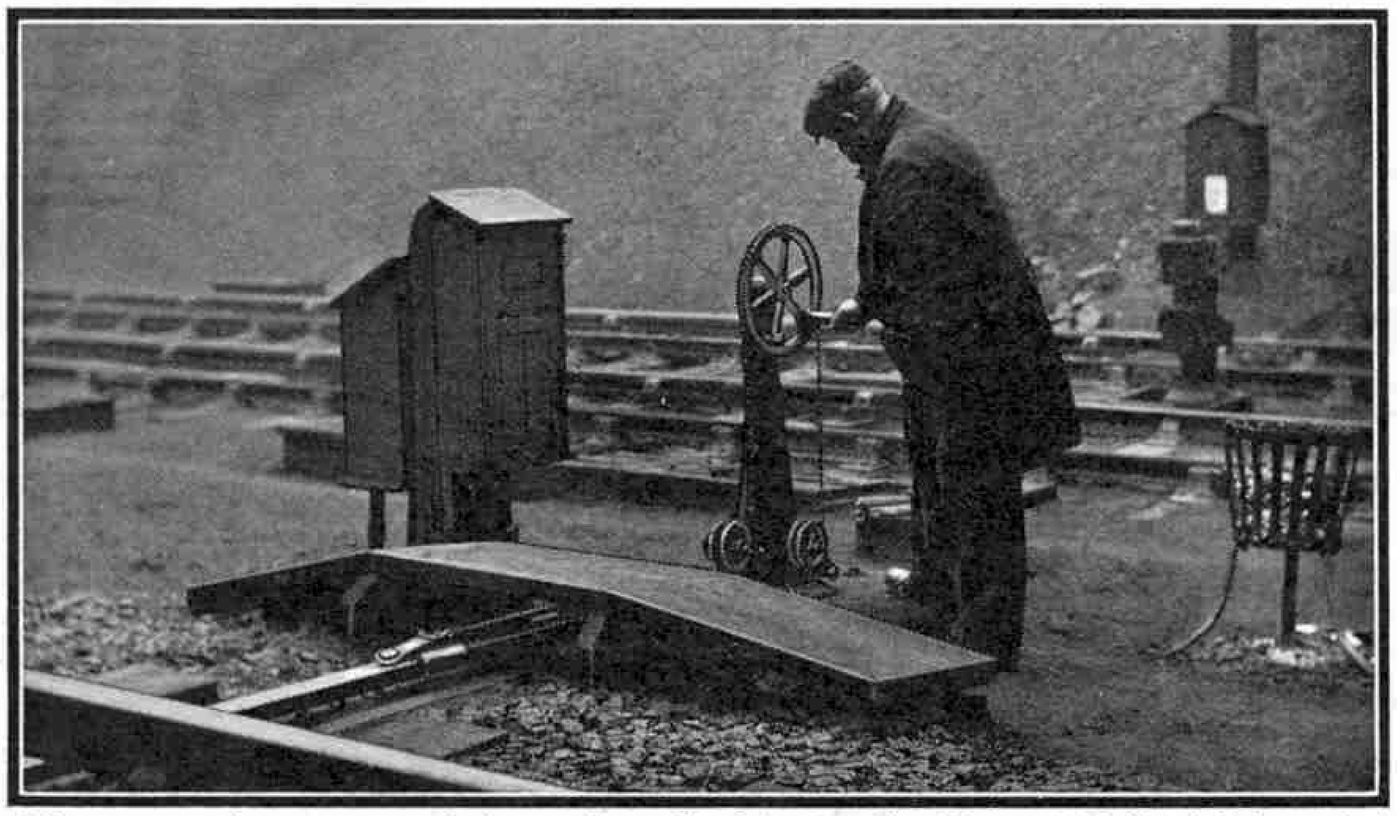
The ordinary fog signal is somewhat similar to a giant "cap" of the type used by boys in toy pistols, but with its explosive mixture housed in a circular metal casing. From the edges of the casing there hang two strips of soft metal that enable the detonator to be placed in position on the rail, and secured by bending the strips round the edges of the rail head. One of our illustrations shows a fogman in the act of placing a detonator on the rail, and in this photograph the clips can be seen. Each detonator contains a quantity of gunpowder, and a sufficient number of percussion caps to make certain that it will explode when a locomotive wheel passes over it. Special care is taken in the manufacture of detonators and in their storage, and rigid tests are made to ensure that they are not affected by damp, heat or cold.

Where several lines are involved on a busy route the fogman has barely sufficient time to put down fresh detonators after the passage of each train, to look out for the trains, and to observe the positions of the signals near which he is stationed. In order to reduce the danger of crossing the line, and to eliminate walking to and fro as much as possible various kinds of detonator placing machines have been devised. These machines are operated by the fogmen by means of a wheel or lever. Some are arranged on the magazine principle, and contain a supply of detonators that are picked up in rotation by an arm that swings them out over the rail. Others take the form of a number of flat metal "fingers" pivoted so that they can be lowered over the rail. To the end of each of these fingers a detonator is attached, and so held in position on the rail head. After each explosion the empty finger is raised by the fogman's lever, and when all the fingers have been raised a fresh supply of detonators must be fitted to them. With these arrangements the detonators placed on the rail when the signals are at danger can be removed if the signals should happen to be altered to the clear position.

Another type of machine is shown in one of our

illustrations. This is operated by a wheel, the rotation of which by the fogman causes a small arm, loaded with a detonator, to be propelled towards the rail.

What of the men who undertake this hazardous and uncongenial, but very necessary task? What do they do when there are no fogs? Fogmen are usually recruited from the platelaying staff, for apart from the daily inspection and any necessary maintenance of the track, no permanent way operations of any magnitude are carried out during fogs, so that the men are thus employed in fog service when otherwise they would be idle. Each fogman has his own particular post assigned to him, so that he can proceed to it without delay in the event of a fog descending. The names and addresses of the fogmen belonging to its particular area are kept in each signal cabin, so that the men can be summoned as quickly as possible by the signalman when fog working is considered to be necessary.



A fogman operating a detonator placing machine. The detonator, clipped to a metal holder, is being pushed towards the rail by rotation of the hand wheel of the apparatus.

Both distant and home signals have fogmen stationed by them, and the explosion of a detonator at the distant signal, and the flag or lamp displayed by the fogman, warn the driver that he is approaching a home signal, which possibly may be at danger. It may be wondered how, if the fog is very thick, the fogman himself knows the position of the signal arm. High signal posts often have a duplicate arm fairly near the ground, known as a repeater. This works in conjunction with the arm at the top of the post, and is very convenient for fog working when the upper arm cannot be seen. If this lower or repeater arm is invisible, the balance weight and lever at the foot of the post usually provides a clue.

When we peer through the window of our compartment after hearing the explosion of a fog signal by our engine, we may catch a glimpse of the fogman standing with flag or lamp in hand by a wooden hut something like a sentry box. These huts are provided by the lineside at most situations where a fogman is stationed. They are fitted with doors as shown in one of our illustrations; not to increase their comfort, but to enable them to be kept locked up and dry when not in use. Here the fogman shelters when he is not busy with his detonators. Where the line runs between retaining walls, or in a solid rock cutting, a kind of "cave" is often formed for his accommodation.

A typical hut for the use of fogmen.

The fogman has a cold job, and each hut is provided with a brazier that glows with a bright coke fire. In addition to improving the generally cheerless conditions this brazier illuminates the scene to some extent, and serves more or less as a beacon for drivers. Its function as a signal reminds us that in the early days of railways, trains on the Stockton and Darlington railway carried braziers full of live coal to serve as tail lamps. Fog working is in some respects a return to the primitive hand signalling methods of a century ago, but of course it is infinitely safer and more efficient. The modern fogman acts only as an interpreter between the signals and the driver, and has the security of the signalling system to rely upon. The early signalmen, or policemen as they were called, had no such assistance, and could only tell whether the line was clear for as far as they could see.

It is interesting to note that in certain spots local conditions are such that what approximates to fog working has to be instituted even when it is unnecessary in other parts of the same district. The cutting between Edge Hill and Lime Street Stations in Liverpool on the L.M.S.R. is a case in point. At the approach to Lime Street the cutting is particularly deep, and as it is through sandstone it has vertical sides. On dull days in winter, therefore, little light can penetrate to the bottom, so that visibility is low in any case and is made worse by the smoke and steam which hang about to a remarkable extent under certain atmospheric conditions.

The up gradient out of the station means that the engines of the frequent departing trains exhaust plentifully, and those pushing out their empty trains also contribute their share to the general gloom. As a precaution, therefore, a fogman is often posted during the winter by the gantry that admits trains to the station to warn drivers of the state of the signals. At the other end of the cutting, approaching Edge Hill, the conditions are aggravated by the presence of a short tunnel over all four tracks, which makes the sighting of the signals just beyond it a difficult matter. The smoke and steam of one train often do not clear before another comes. A fogman is therefore stationed at this point also.

"Dabeg" Feed Water Heaters on L.M.S.R.

Some years ago one of the L.M.S.R. "Horwich" 4–6–0 locomotives was experimentally fitted with a "Dabeg" feed-water heater and pump. This engine, No. 10434, was illustrated on page 521 of the "*M.M.*" last July, and on page 955 of the December issue we reproduced a photograph of No. 9673, one of the three L.M.S.R. 0–8–0 locomotives fitted with A.C.F.I. feed-water heating apparatus. Experiments in this direction are now being extended, and the illustration on this page shows No. 633, one of the L.M.S.R. standard 4–4–0 "2P" passenger engines that has been recently fitted with "Dabeg" feed water apparatus for this purpose.

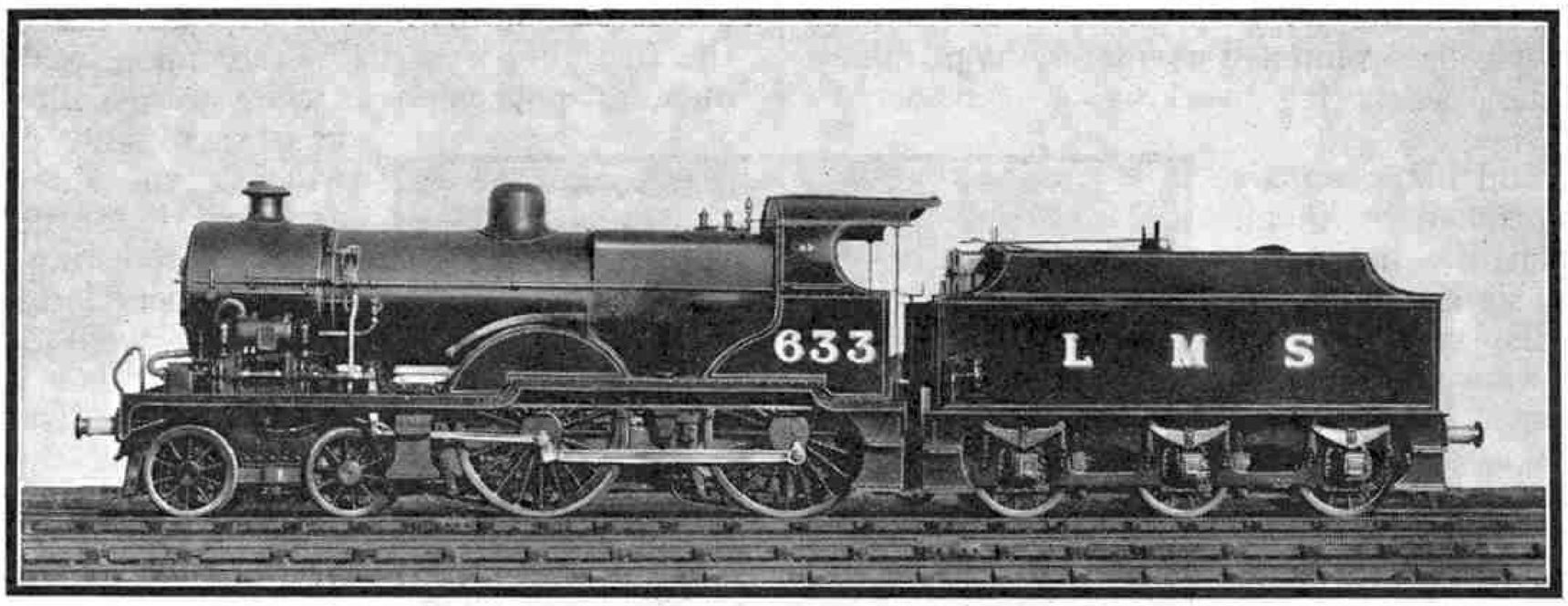
The "Dabeg" apparatus is a device by means of which heat that ordinarily would be exhausted into the atmosphere is reclaimed and utilised to heat the feed water before entering the boiler. Apart from the fuel economy that should result from pre-heating the feed water, it is claimed that use of this apparatus will reduce boiler maintenance charges, for less scale will be deposited.

The pump is carried on the left-hand side of the engine above the platform. The body of the pump comprises two sections, one forming the cold water end, and the other the hot water end, with the condenser carried on the top. The drive for the pump plunger is taken from a return or lazy crank on the leading crank pin through a suitably arranged rod and rocking lever carried on the engine main frame. The pump, condenser and delivery pipe, and the operating gear are shown in the photograph.

The movement from right to left of the plunger in the cold water section draws cold water from the tender feed, and on the return stroke the water is delivered into the condenser through a perforated pipe so that it falls in the form of a fine spray through exhaust steam fed to the condenser from the blast pipe. This steam quickly condenses and gives up its heat to the feed water. The movement of the plunger from left to right at the hot water end draw heated water from the condenser and delivers it on the return stroke through a clack box on the left-hand side of the boiler. Thus, for each revolution of the driving wheel, the pump draws cold water from the tender and delivers it hot to the boiler when the regulator is open.

An automatic feed valve on the pump prevents any cold water from passing into the condenser when the regulator is closed, and thus the action is automatic and independent of the driver, who has only to attend from time to time to the water regulating cock handle placed in the cab, which controls the supply of cold water to the pump. In addition to this feed water pump, an ordinary live steam injector is fitted to the engine.

The experiments are being carried out to the requirements of Mr. W. A. Stanier, Chief Mechanical Engineer of the L.M.S.R.



L.M.S.R. No. 633, one of the standard 4–4–0 locomotives of Class "2P," now fitted with the "Dabeg" feed-water heater and pump described on this page. Photograph by courtesy of the L.M.S.R.

New Tank Locomotives for Irish Railway

Some smart 0–6–2 tank locomotives have been built by the Great Southern Railways (Ireland) at their Inchicore works to the designs of Mr. A. W. Harty, Chief Mechanical Engineer of the Company, for the services between Dublin and Bray, and Dublin and Dun Laoghaire. They have coupled wheels 5 ft. 6 in. in diameter and inside cylinders with a diameter of 18 in. and a stroke of 24 in. The boiler has a total heating surface, including superheater, of 886 sq. ft. and a working pressure of 160 lbs. per sq. in. The grate area is 18 sq. ft. The tanks have a capacity of 1,500 gallons of water and the bunker accommodates 3 tons of coal. The weight in working order amounts to 57 tons 7 cwt. Five of these engines have been built and they are known as the "670" class, that being the number of the first of the series.

Progress on the L.N.E.R.

Added comfort for the passenger and improved efficiency and economy in working are aimed at in some of the recent decisions made by the authorities of the L.N.E.R.

For the future, arm-rests are to be fitted in all 3rd-class corridor coaches running on the Anglo-Scottish services. All new stock will be built with them and they will be added to the carriages already running as these come into the shops.

Colour-light signalling is being installed to expedite the traffic on the busy suburban branch line from Clapton to Enfield.

The L.N.E.R. are also at present considerably extending the practice of water-softening for locomotive purposes, and 14 water-softening plants are in course of construction at places on the main line between King's Cross and Doncaster. Contracts have been placed for similar plants at nine points in London and the Eastern Counties. These will have a capacity of 697 million gallons per annum.

New Dining Cars for the L.M.S.R.

Since his appointment as Chief Mechanical Engineer of the L.M.S.R., Mr. W. A. Stanier has introduced a number of improved designs for the passenger rolling stock of the Company. A new combined first-class dining and kitchen car which was brought to Euston for inspection recently is a very handsome and finely equipped vehicle. It is 68 ft. in length and 9 ft. 3 in. in width, weighs 45 tons and is carried on two six-wheeled bogies. It has a seating capacity of 24. The decorations are very tasteful and the upholstery affords the utmost comfort.

L.N.E.R. Locomotive News

The first of the new powerful 2–8–2 "Mikado" express locomotives under construction at Doncaster is expected to be in traffic shortly. It will be classified "P.2." Doncaster works are also engaged on a new batch of 2–8–0 freight locomotives, and the first of them—No. 2430—is already at work.

New "Castles" for G.W.R.

An order for six small 0–6–0 outside-cylinder, tank shunting engines is in course of execution at Swindon works. They will have 3 ft. 8 in. wheels, and cylinders with a diameter of 16 in. and a stroke of 20 in. Their numbers will run from 1366 to 1371. It is interesting to recall that as long ago as 1910 a batch of engines of this class—numbered 1361 to 1365—was built at Swindon. In their chief dimensions the new engines are similar to the earlier ones, but many improvements in detail are being introduced. The new cab is roomier, and pannier tanks are substituted for the former saddle tanks. The brake gear and lubrication equipment are also improved. The first of the new engines has just been completed and it is expected that the others will all be finished by the end of this month.

Five of the new 4–6–0 express locomotives of the "Castle" class are now well advanced in the erecting shop and probably one will be ready for the road early in April. The numbers and names allotted to the ten new "Castles" are as follows:—5023, "*Brecon Castle*"; 5024, "*Carew Castle*"; 5025, "*Chirk Castle*"; 5026, "*Criccieth Castle*"; 5027, "*Farleigh Castle*"; 5028, "*Llantilio Castle*"; 5029, "*Nunnery Castle*"; 5030, "*Shirburn Castle*"; 5031, "*Totnes Castle*"; 5032, "*Usk Castle.*"

As a result of experiments that were reported in the "*M.M.*" several months ago, it has been decided to equip the principal high-speed passenger engines on the G.W.R. with speedometers. The work will be done in stages, and to begin with speedometers are to be fitted to 100 engines.

During last year 103 new locomotives were built at Swindon works, comprising 40 engines of the 0–4–2T type, classes 48XX and 58XX; 13 of the 2–6–2T type, class 61XX; 20 of the 4–6–0 type, class 59XX; and 30 of the 0–6–0T type, classes 97XX and 87XX.

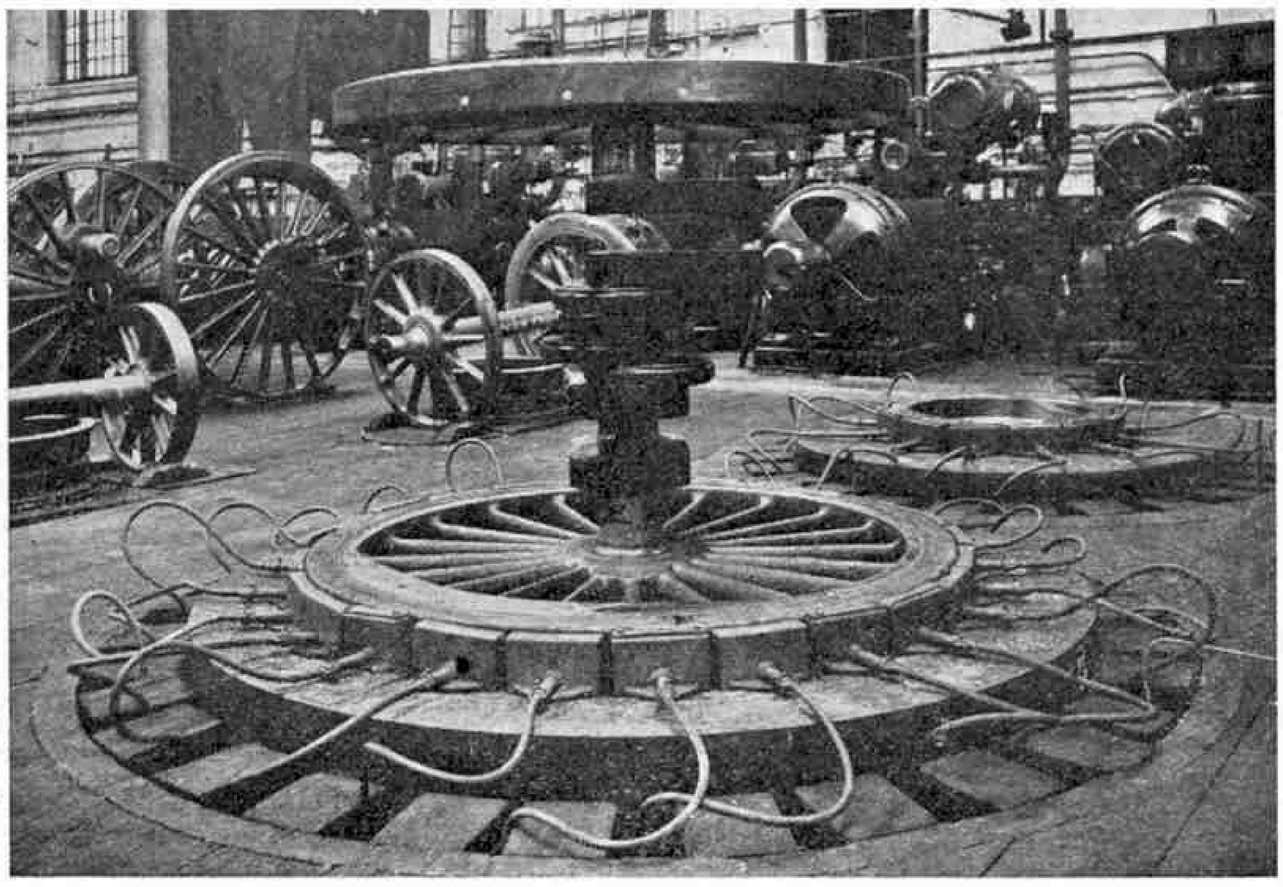
In the course of the year 92 locomotives were condemned. Among them were some 4–6–0 express engines of the "Star" and "Saint" classes. The 4–4–0 locomotives that were scrapped included all the remaining engines of the "County" class, the last to go being No. 3834, "*County of Somerset*," one of the first batch built in 1904.

Reconstruction of Paddington Station

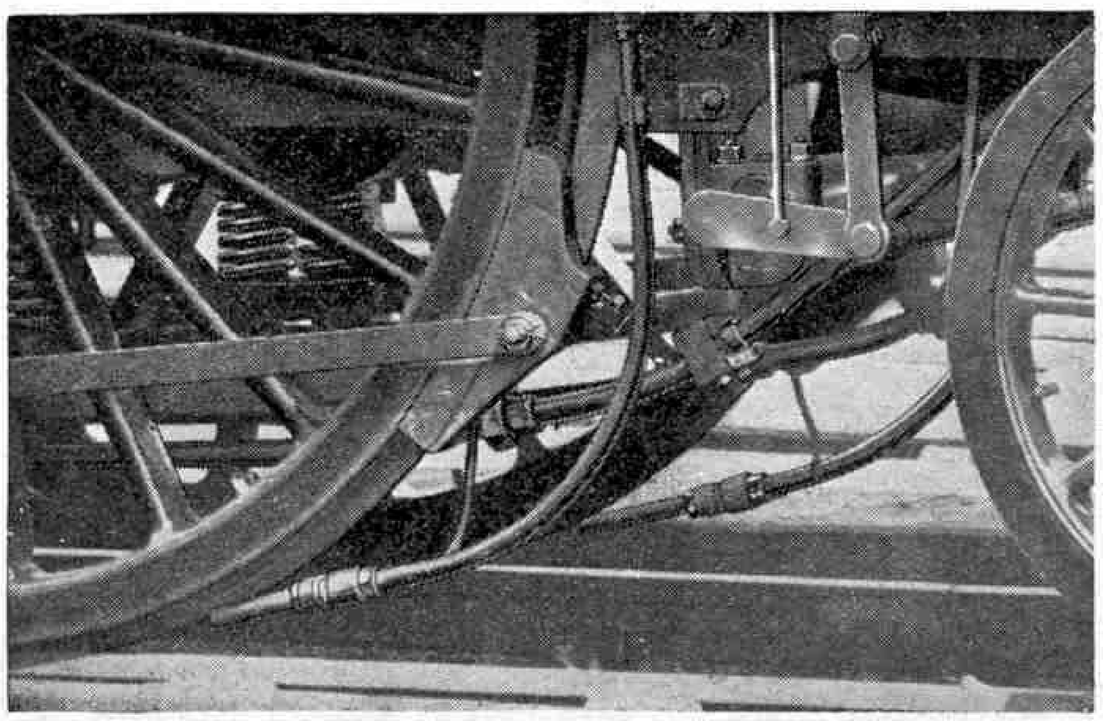
The great task of reconstructing Paddington—the famous London terminus of the G.W.R.—is practically completed. The whole of the platforms, which have been increased in number from 14 to 16, are now from 600 ft. to 1,240 ft. in length. As a result of these extensions Paddington can now claim to have a greater total length of platforms than any other station in Great Britain, Victoria alone excepted. In all, they measure 15,030 ft., or nearly 2¾ miles. In addition there are two platforms, used chiefly for parcels traffic, that measure 1,511 ft. The three main departure platforms, Nos. 1, 2 and 3, are each over 1,100 ft. in length, but the longest platforms are Nos. 8 and 9 which are 1,200 ft. Each platform is provided with a lift communicating either with the subway below the station or the footbridge above it.

Many of the old station buildings have been pulled down and replaced by modern structures. Very marked improvements have been effected in the circulating area between the station entrances and the platform. This area is commonly known as "The Lawn," and it has been re-roofed and remodelled, while the refreshment rooms, cloak rooms and various offices around it, have been made much more convenient and attractive. Another very obvious improvement is in the subways connecting the main line station with the two "Underground" stations. These formerly were narrow, dull and inconvenient, but are now spacious, bright and airy.

The reconstruction and enlargement of Bishops Road station, which were included in the scheme, have also been carried through. This station has now lost its separate existence and name and has become the suburban section of the great Paddington station, most of the local services being worked from its platforms.



A special gas-heated furnace of the pattern used in locomotive works for heating wheel tyres before they are shrunk on to the wheel centres, or before their removal. From "A British Railway Behind the Scenes," reviewed on page 219.



The sand pipes and part of the brake gear of a 4–4–0 locomotive of the former S.E.R. This engine was designed by Mr. J. Stirling, and fitted with his steam-operated reversing gear, part of which can be seen between the driving and bogie wheels.

Opening of the Greenisland Loop Line

The new Greenisland loop line on the L.M.S.R. (Northern Counties Committee) was opened for traffic on 17th January last, the ceremony being performed by the Duke of Abercorn, the Governor of Northern Ireland. The new loop gives a valuable connection between the two lines that branch from Greenisland to Belfast in the south and to Portrush and Derry in the west. In addition to considerable embankments and cuttings, the undertaking has included the construction of two concrete viaducts that are the largest of their kind in the British Isles. The work has taken two years to complete and has cost about £200,000.

The four 2–6–0 type locomotives recently constructed at the L.M.S.R. Derby works for the N.C.C. section will be used to provide accelerated services between Belfast and Portrush and other places. The first engine, No. 90, has been named "*Duke of Abercorn*," in honour of the Governor, and the class as a whole will be known by that name. The other three engines are named after important rivers in Northern Ireland, as follows:—No. 91, "*The Bush*"; No. 92, "*The Bann*"; and No. 93, "*The Foyle.*"

Veteran M.R. Locomotives at Work

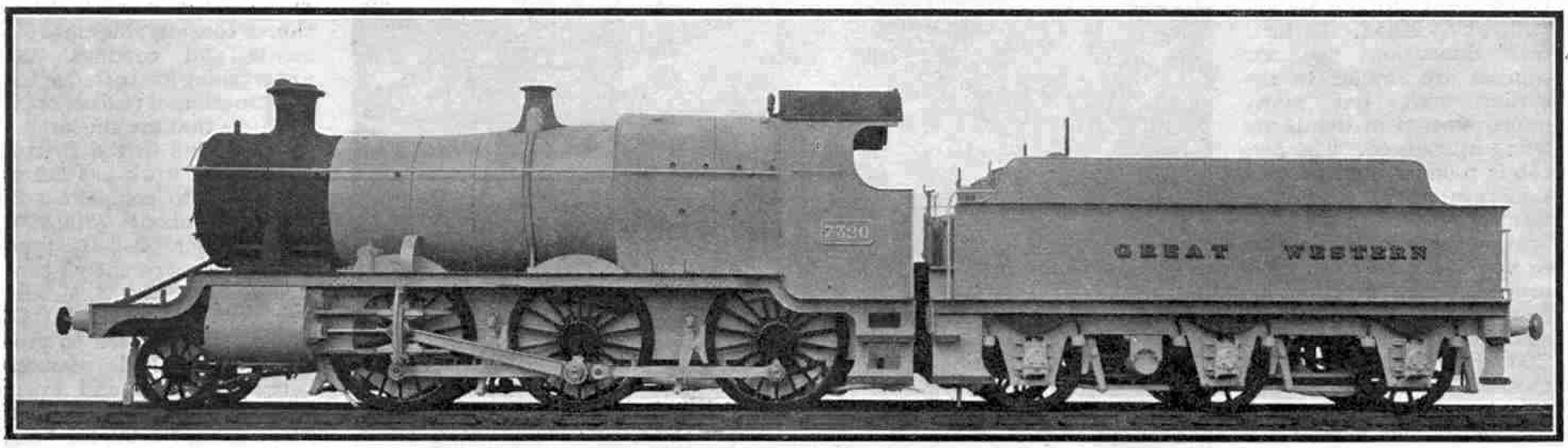
The order for 40 improved 2–6–0 "Mogul" mixed-traffic locomotives, to be numbered 13245 to 13284, has just been completed at Crewe, and work is going forward on further three-cylinder express locomotives of the "Baby Scot" type.

The policy of scrapping inefficient engines is being rigorously pursued on the L.M.S.R. Thus, while 12 new engines were added in December last, no less than 53 old engines were withdrawn from service, including 14 L.N.W.R. "Experiments" and 3 "Precursors"; one L.Y.R. 4–4–0; two H.R. 4–4–0's of the "Small Ben" class; and one M.R. Kirtley 2–4–0. The freight engines withdrawn were of the older 0–8–0 and 0–6–0 classes. Among the tank engines withdrawn were a L.T.S.R. 4–4–2 and a C.R. 4–4–0.

On 1st January the only remaining member of the famous L.N.W.R. 2–4–0 "Jumbos" or "Precedents" on the Company's books, apart from "Hardwicke," which is preserved as a historic locomotive, was No. 5001, "*Snowdon*," which was still in service in the Workington district. It may be added that several old M.R. Kirtley 2–4–0 locomotives are still in active work and No. 2 was seen by a correspondent at New St. Station, Birmingham, on 30th December last. No. 8 is in service in the Liverpool district, where it is used in inspection duties. They belong to a class originated in 1866; No. 2 was built in that year and No. 8 in 1867. The first of them, No. 1, is preserved at Derby with its former duplicate number "156A" reinstated.

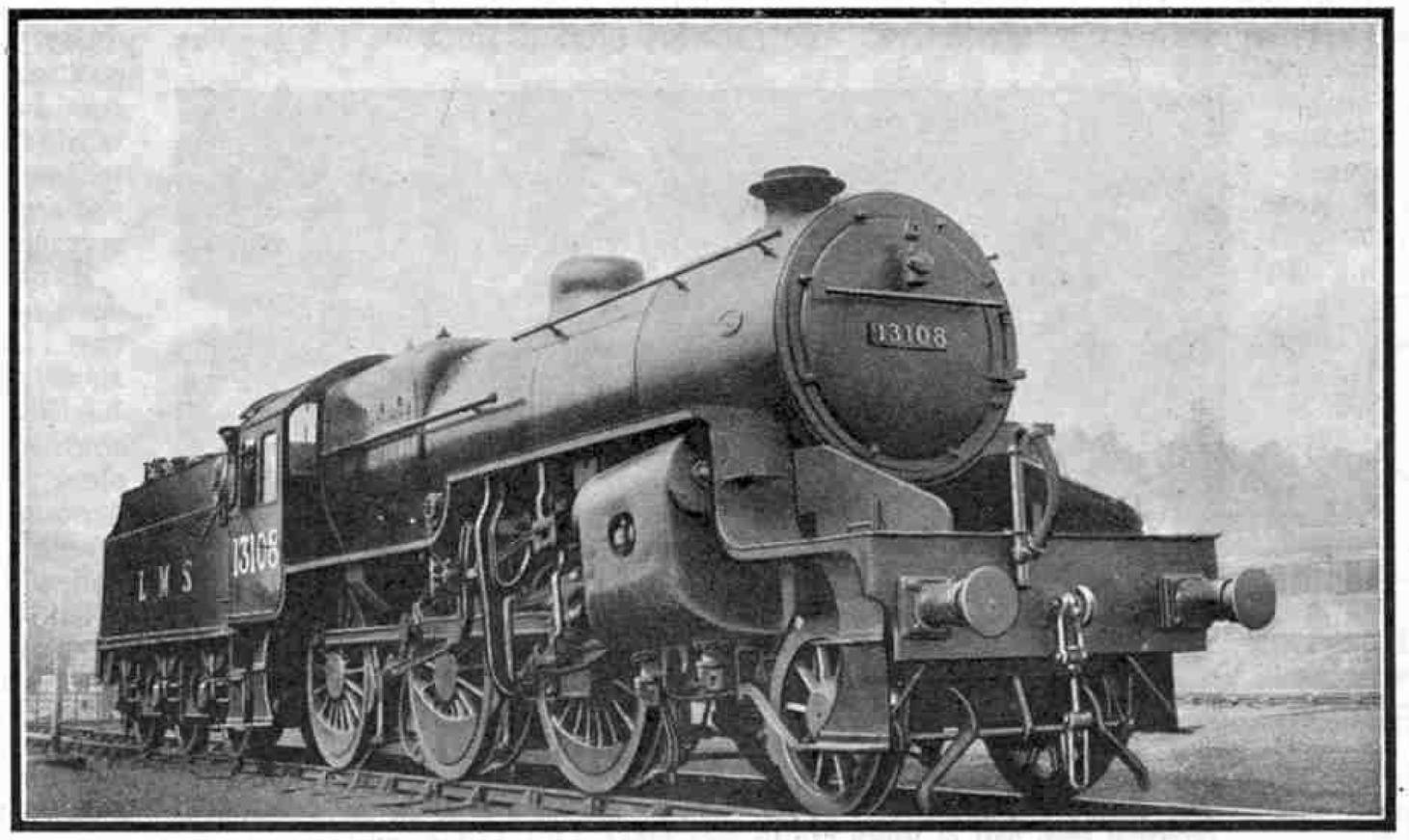
The "Mogul" Locomotive in Great Britain

II.—Its 20th Century Development



LAST month we dealt with the development of the 2–6–0 or "Mogul" type of locomotive in this country from the earliest examples of 1879 up to the imported American engines of 1899, that were put into service on the G.N., G.C. and Midland Railways. The next appearance of the type was in 1911 on the G.W.R. These engines were totally unlike the "Aberdares" already in service on that line, and were of the real "Mogul" pattern with outside cylinders. They were introduced by Mr. Churchward, who had succeeded Mr. Dean at Swindon, and they were intended for mixed traffic and semi-fast passenger trains.

These "Moguls" have been very successful, and over 300 engines of the class are now running on the system. Thirty-five were built by Robert Stephenson & Co. Ltd., at Darlington, but all the rest have been constructed at Swindon. Those supplied by the outside builders were added to the stock during the difficult period following the War, when the shops of the various railway companies were considerably disorganised and locomotives were urgently required. The typical features of the class may be gathered from the illustration of No. 7320 on this page. Side stays connect the smoke-box and the front footplate in the same manner as on the American "Moguls." The class is characteristic of 20th century G.W.R. locomotive practice, and the standard features of construction found in that company's engines are incorporated.



The upper illustration shows one of the useful G.W.R. 2–6–0 locomotives. These are true "Moguls," and incorporate several features of American practice. In the lower photograph is one of the remarkable-looking 2–6–0s of the L.M.S.R. that are used with success on all kinds of trains.

In the year after the G.W.R. class was introduced, a 2–6–0 design appeared on the Great Northern Railway, Mr. Gresley being the locomotive engineer responsible. Its latest development is found in the massive "K3" three-cylinder engines now standard on the L.N.E.R. These first 2–6–0's inaugurated the systematic use of outside cylinders and valve gear on many of the Great Northern engines, and these features have characterised most of the designs produced on the G.N.R. and the L.N.E.R. by Mr. Gresley.

The success of the initial design paved the way for the first three-cylinder 2–6–0, No. 1000, which made its appearance in 1920. This created quite a mild sensation at the time, owing to its exceptionally massive appearance. The boiler diameter, for the first time in British locomotive history, reached 6 ft., and in consequence the chimney was of limited height. Valuable work was performed by the engines of this class on extremely varied duties, so that the term "mixed traffic" describes the nature of their work very well. During the coal strike period of 1921 these engines were to be found hauling trains of 18 and 20 coaches on quite fast schedules, and there is no doubt that they proved of great value to their owners during that time. In these engines the now well-known Gresley valve gear arrangement for actuating three valves with two sets of motion is used, this having been introduced in 1918 on No. 461, a three-cylinder mineral engine of the 2–8–0 type.

Upon the formation of the L.N.E.R. Mr. Gresley assumed contro of the locomotive department, and the same general design of these fine engines was followed in the now familiar "K3" class. In order to fit them for service on the North British section, various modifications were introduced, the boiler mountings being cut down, so that these latest engines appear more massive than ever. Further, the double-window cab that had been introduced in 1922 on the first two Gresley "Pacifics," and had been standard on the N.E.R. since 1886, was adopted. These alterations, together with a standard high-sided tender following Darlington practice, combined to make a very fine-looking engine.

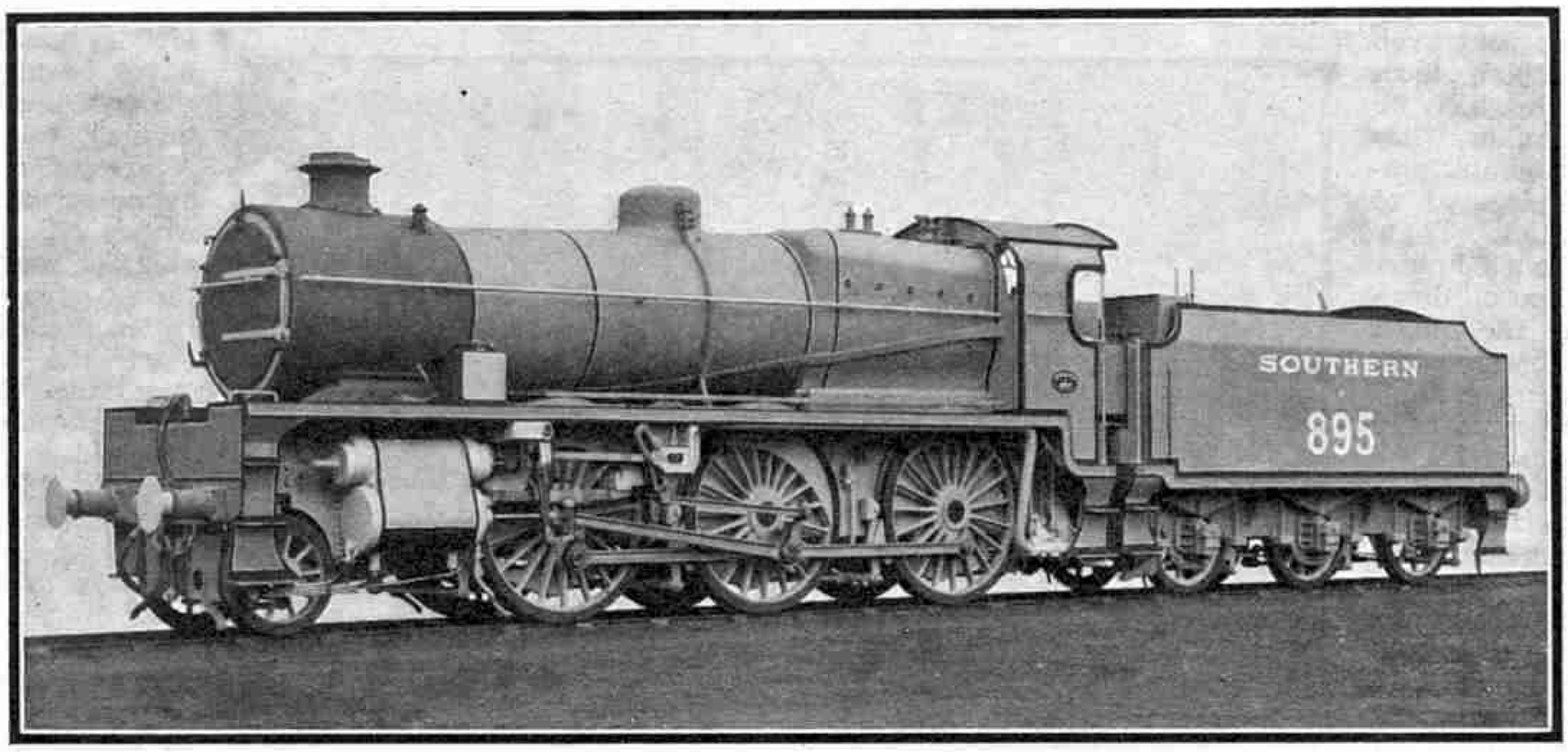
Another designer to recognise the possibilities of the "Mogul" was Mr. L. B. Billinton, who introduced the type on the London, Brighton and South Coast Railway in 1913. These engines have two outside cylinders, but the valve chests and motion are between the frames. There are in all 17 of this class, and they carry the numbers 2337-2353. They have been supplanted to some extent by the various "Moguls" built by Mr. Maunsell.

The next two series of 2–6–0's appeared in Scotland on the Caledonian and Glasgow and South Western lines. They are alike in general design and appearance, and in the fact that they were developed from previous 0–6–0 engines. For this reason, therefore, we will consider them together, though chronologically the Billinton "Moguls" should separate them. These Scottish designs have inside cylinders, and in each case the adoption of the leading pony truck was probably due to the desire to add a

superheater to the existing 0–6–0 design. The truck was therefore incorporated to relieve the leading coupled axle of excessive weight.

The Caledonian engines were four in number, and were brought out in 1912 by Mr. J. F. McIntosh. Their appearance was well shown in the illustration on page 129 of last month's "*M.M.*" from which it will be seen that all the features characteristic of the locomotives produced by that designer are included. The shape of the chimney, the safety valve casing, and the sheet iron " wings " at the front end of the smoke-box are particularly to be noted in this connection. The four engines of this class are still in service, and bear L.M.S.R. numbers 17800 to 17803.

In 1915 Mr. P. Drummond, on the Glasgow and South Western Railway, introduced his version of the 2–6–0. Eleven of this class were built by the North British Locomotive Company, and they were in general design superheated variations of the 0–6–0 goods engines brought out in 1913 by the same designer. They conformed with the standard practice of the day obtaining on the G.S.W.R. under the Drummond regime, and are all at present running under L.M.S.R. numbers 17820 to 17830. They have a more massive appearance than the Caledonian engines of the same type, and their weight is some eight tons greater, being 62 tons in working order. The adhesion weight is 54.35 tons.



One of the Southern Railway 2-6-0 locomotives of Class " U1." This class with 6 ft. diameter driving wheels and three-cylinder propulsion forms one of the latest developments of the " Mogul " in this country, and is intended more particularly for passenger traffic on difficult sections, such as Waterloo to Portsmouth, Charing Cross to Hastings and in the West of England.

There are also several examples of inside cylinder 2–6–0's in Ireland.

Apart from the Billinton engines, the Southern Railway " Moguls " have been developed from the initial design introduced by Mr. Maunsell in 1917, when he was chief mechanical engineer of the late South Eastern and Chatham Railway. This pioneer engine, No. 1810 of the S.R., was notable for including several features common to G.W.R. practice, the raised running plate, the coned boiler with top-feed apparatus and the shape of the Belpaire fire-box all being suggestive of Swindon. It is also interesting that the dome cover merely houses the top-feed delivery apparatus, so that the engine is actually provided with a domeless boiler. This also points to G.W.R. practice, though domeless boilers had been standard practice on the old South Eastern many years previously, under the superintendence of Mr. James Stirling. Two outside cylinders with valves on top, Walschaerts valve gear and the flat-sided tender, not unlike those of the Midland pattern now standard on the L.M.S.R., were also features of note.

These engines have been multiplied since grouping, and they have been found excellent in general service on the Southern Railway, especially for the hauling of fast goods trains between London and the West of England. They have done particularly good work on the heavy gradients west of Exeter, but they are employed also on the Eastern section, for which they were first developed. It is interesting to note that this design was chosen in order to provide work for Woolwich Arsenal after the termination of the War, and many parts for these locomotives were manufactured there. Some of these parts have been utilised in the construction of 2–6–4 tank locomotives of similar general design for the Metropolitan Railway, and also for 2–6–0 tender engines adapted for the 5 ft. 3 in. gauge of the Great Southern Railways of Ireland.

In multiplying the first batch of these Ashford 2–6–0's, an interesting experiment was made by Mr. Maunsell in providing one of them, now No. 1822, with three cylinders, the inside one being inclined so as to drive on the middle axle. Two sets of outside Walschaerts valve gear were provided, and arranged to drive in addition the valve of the inside cylinder, through a system of levers. In order to accommodate the cross-levers at the front end, the footplates round the smoke-box saddle do not slope down as at the cab end, but instead a very deep buffer beam is provided. A solid and forbidding appearance is thus given to the engine when viewed head-on. In most other respects this engine is identical with the two-cylinder examples already mentioned, and the three-cylinder arrangement was provided in order to compare the performance and relative maintenance costs of the two types of locomotive. To assist the comparison the three-cylinder engine had its boiler pressure reduced to 190 lb. from the 200 lb. per sq. in. carried by the two-cylinder engines, thus making the respective tractive efforts more nearly equal. Further engines of similar pattern, but with three sets of valve gear, have since been built.

In a similar manner there was a three-cylinder member of the former " River " class of 2–6–4 tank locomotives. On the rebuilding of this class as tender engines of the 2–6–0 wheel arrangement, it retained its three cylinders, and thus bears the same relation to the older three-cylinder engine, No. 1822, as the reconstructed tanks do to the original Ashford pattern engines. Thus, whereas the latter, including No. 1822, have driving wheels 5 ft. 6 in. in diameter, the rebuilt "Rivers" and their three-cylinder variant No. 1890, have wheels 6 ft. in diameter. Additional two-cylinder engines with 6 ft. wheels, similar to the reconstructed " Rivers," have been added to the S.R. stock, and a recent development in the company's practice has been the production of a number of locomotives similar in general design to the reconstructed three-cylinder No. 1890. In these, however, separate sets of Walschaerts valve gear are provided to actuate the valves of the three cylinders.

In spite of this activity in building 2–6–0's on the part of other railways, the L.M.S.R. group, and previously its chief constituent lines, showed little inclination to follow their lead. Thus the principal engines for miscellaneous duties on the L.N.W.R. and the Caledonian were of the 4–6–0 type, and in both cases they were small-wheeled versions of the respective 4–6–0 passenger engines of the day. In addition much mixed-traffic working was carried out by 0–6–0 locomotives on these systems, and on the Midland.

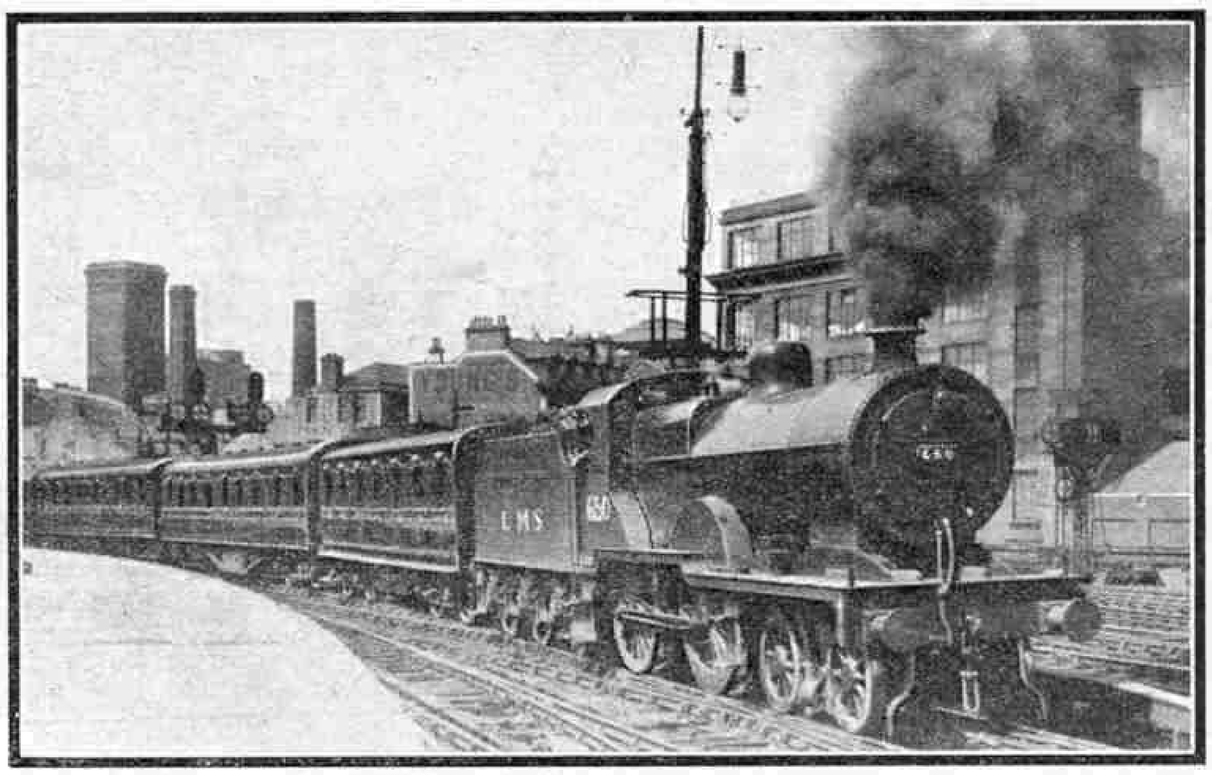
For some time there appeared little likelihood of the appearance of a 2–6–0 locomotive, but in 1926 the first standard L.M.S.R. " Mogul " was turned out from Horwich. This had been designed previously by Mr. George Hughes, the first chief mechanical engineer of the L.M.S.R., but the class was introduced after Sir Henry Fowler had assumed that position. The first 30 were constructed at Horwich, and almost simultaneously 70 were put in hand at Crewe. Since then considerable additions have been made to the class, and there are now altogether 245 of them in service, so that the tardy adoption of the type has been made up for by the speed with which it has multiplied. These engines provoked a great deal of comment when they first appeared, as they have such steeply-inclined cylinders and high frames. These features combined with a massive motion plate, and complicated-looking Walschaerts valve gear, give them an appearance that is unique in British practice. A striking view of No. 13108 on page 210 gives a splendid impression of their main characteristics. A standard tender of Midland pattern is provided, but the boiler mountings and cab show that the design originated at Horwich. The most recent 2–6–0s produced by the L.M.S.R. have tapered boilers and a more normal disposition of the cylinders.

The " Mogul " is therefore now well established in Great Britain. The early Great Eastern and imported American engines cannot be said to have had much influence on subsequent locomotive practice, so that the real development of the type has occurred within the last 20 years, and the examples now running are nearly all modern. The type certainly has definite advantages. It allows of a greater expansion of the boiler than is desirable with the widely-used 0–6–0 type of locomotive ; larger outside cylinders can be used, and it is possible to produce a powerful, yet compact locomotive.

Locomotive Progress at St. Enoch

Old and New L.M.S.R. 4-4-0s

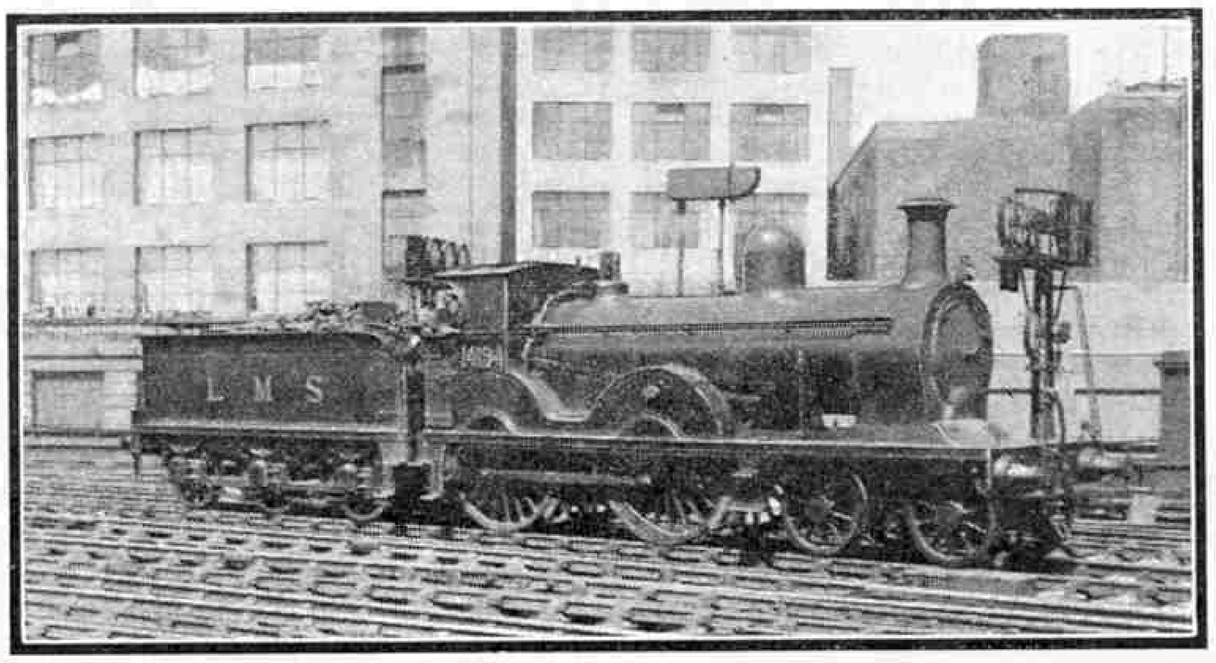
DURING the 10 years that have elapsed since the grouping of our railways, numerous interesting developments have occurred. Among these has been the appearance of new and more powerful locomotives from time to time their production being occasioned by the constant increase in the weight of the trains and the luxury of travel. The coming of these locomotive giants, with which we are now so familiar, has caused their immediate predecessors to be relegated to less important duties. These in their turn have ousted older locomotives; and so on down the scale so that the oldest have gradually been withdrawn from service. Here and there certain exceptions have occurred, where special conditions obtain and the duties are satisfactorily performed by the old engines that may have been so employed for a large number of years. Again certain engines may have been in a better state of repair than other members of a class for various reasons, and thus old survivors of this kind are not uncommon. Even so, the necessity of standardisation makes their withdrawal from service in due course a certainty.



Standard features of L.M.S.R. locomotive practice are to be seen in this illustration showing a class "2P" 4-4-0 locomotive. This and the photograph below were taken at St. Enoch Station, Glasgow, by our reader Mr. J. M. Craig.

In order to obtain a satisfactory standard of power for secondary duties, most of our railways have found it necessary to build a number of locomotives of the lighter kind, which, in spite of relatively small proportions are thoroughly up to date, and show an appreciable economy in operation when compared with older engines that they replace. This partly explains why it is possible to observe quite up-to-date locomotives on more or less obscure duties at times, and some readers have no doubt wondered why an engine bearing perhaps the date 1931 should be seen working on a remote service with quite an insignificant load.

The two photographs on this page, which were both taken at St. Enoch Station, the Glasgow terminus of the G. & S.W.R. section of the L.M.S.R., illustrate in a striking manner a representative of the old order in No. 14194, and an example of new construction in No. 650. The former engine is one of the former "Manson" "No. 8" class of the old "Sou-Western," of which 57 were built over a period of years, and until quite recently they were used on the secondary train services, both main line and branch. Under the L.M.S.R. regime many of them have been scrapped, and the engine shown is one of the few survivors. It formerly carried the number 431, and although now bearing the L.M.S.R. number 14194, it still shows features that marked the older race of G. & S.W.R. locomotives, except of course that the neat green coat has been replaced by the L.M.S.R. standard livery. When built in 1896 it was No. 110, becoming No. 431 in 1919, when the G. & S.W.R. numbering was revised. At the same time modifications were made in the valve gear of most of the class, and the position of the reversing rod was altered. As built, this emerged from the cab, and ran parallel to the foot-plating; being supported on top of the leading splasher, and connected to the gear by a long and somewhat clumsy arm.



A former G. & S.W.R. locomotive, many of which have been replaced by the "2P" engines and the Compounds. It was built in 1896 and rebuilt in 1919, but still shows the characteristic features of the older "Sou-Western" engines.

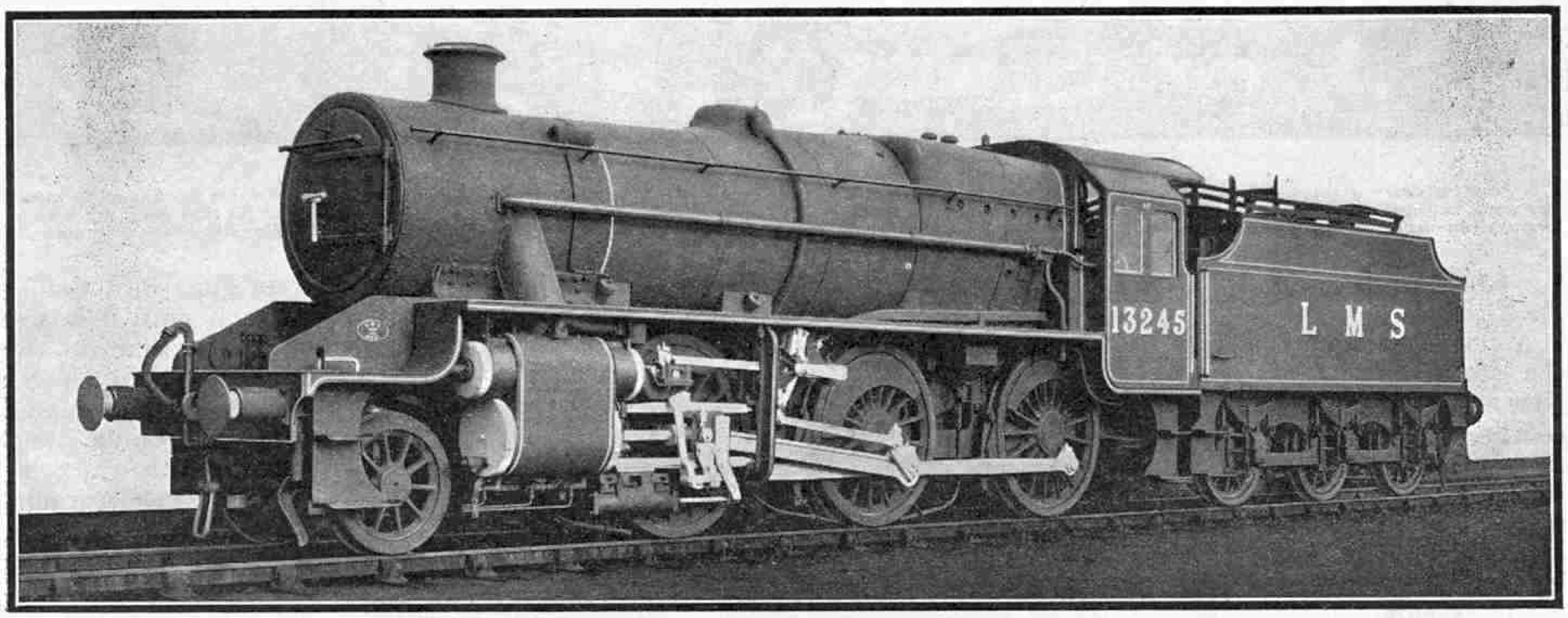
The other engine is characteristic of recent Derby practice, though strangely enough it was built at Crewe, and is one of the many "2P" passenger locomotives turned out during the last few years. These engines have been developed from the well-known "Class 2 Rebuilds" of the old Midland Railway, but they have smaller cylinders and smaller driving wheels. To render them suitable for service anywhere on the company's lines, their boiler mountings are cut down from the original Midland standards. This feature, and the high-sided tender, neither of which was found with the original "Class 2" engines, gives them a disproportionately massive appearance. Numbers of these engines have been drafted to the Northern Division of the L.M.S.R., and are doing good work, particularly on the difficult G. & S.W.R. section. They are also found on the Central Division in England, as the former L. & Y.R. is now known, and some of them were allocated when built to the Somerset and Dorset Joint Railway; but they have been returned to the L.M.S.R. stock since that company has taken over the maintenance of the locomotives of the line.

The comparison between the two engines illustrated is extremely interesting. Both are of the inside-cylinder 4–4–0 type that was practically the British standard for express services for so long; but apart from this they have little else in common, although their driving wheels do not vary in diameter by more than half-an-inch. The short smoke-box, small boiler, and the cab of the "Manson" engine are entirely different to the extended smoke-box, Belpaire-pattern boiler, and the cab with extended roof and rounded top corners as fitted to most Derby-type engines. In the older locomotive provision is made for oiling the coupling rod pins when on top centre by means of little openings at the bottom of the splashers. The same object is attained in the modern locomotive by raising the foot-plating so as to clear the throw of the coupling rods —a feature that is found in most of our up-to-date locomotive designs. The bogie brakes of the modern 4–4–0 are a refinement that the older engine lacks, and there is a surprising difference in the relative proportions of the chimneys and domes of the two. Similarly, the somewhat tall open-column "Ramsbottom" safety valves of the "Manson" engine are replaced by two short and apparently insignificant, but very efficient, "pop" valves.

Their tenders, too, are equally contrasting. The relatively plain flat-sided Derby tender, holding 5 tons of coal and 3,500 gallons of water, is essentially an up-to-date vehicle, and fitted with water pick-up apparatus. This gear is not found on the older and smaller tender, as track troughs have only been laid on the G. & S.W.R. section since the inclusion of that line in the L.M.S.R. group.

New L.M.S.R. 2-6-0 Locomotives

Some Interesting Features of Design



ELSEWHERE in this issue there appears the second instalment of the article dealing with the development of the 2–6–0 or "Mogul" type of locomotive in this country. In this the recent appearance of a new 2–6–0 design of the L.M.S.R. is mentioned, and particular interest is attached to the 40 engines now completed at the works at Crewe in that they embody the modifications applied by the present Chief Mechanical Engineer, Mr. W. A. Stanier, to the original standard design produced by Mr. G. Hughes and Sir H. Fowler.

A remarkable feature of the first or "13000" series of L.M.S.R. 2–6–0s, is the steeply inclined cylinders placed high up on the main frames, giving the engines a unique appearance at the front end. In the new design illustrated on this page the cylinders have been dropped to a horizontal position. The running plate above them is therefore more orthodox in outline than that of the original engines, and this has resulted in a considerable gain in appearance. The engine illustrated above, No. 13245, the first of the new series, looks solid and well built.

As in the case of the fine "Pacifics" Nos. 6200 and 6201, the boiler barrel is tapered; the fire-box, too, is suggestive of Swindon practice, and this is expressed also in the smoke-box arrangements and other details. The boiler pressure of the new engines, which are numbered from 13245 to 13284, has been fixed at 225 lb. per sq. in., whereas the earlier engines worked at 180 lb. pressure. The superheater is arranged to give a moderate degree of superheat, and its header in the smoke-box accommodates the main regulator valve. The dome-shaped cover on the boiler barrel thus provides access to the top feed delivery apparatus and distributing trays, and in this respect the new engines resemble the S.R. "Moguls."

The outside cylinders are reduced in diameter from 21 in. to 18 in., but the piston stroke is lengthened from 26 in. to 28 in. as compared with the original engines. This alteration is due to the increased boiler pressure, and the reduced diameter of the cylinders has enabled the horizontal position to be adopted for them, which results in a more compact arrangement of the motion generally.

The piston valves and cylinders are provided with mechanical lubrication, and a steam atomizer to each point of delivery. The piston rod packings, which are of the cast-iron type, and the valve spindle bushes, are also mechanically lubricated. The lubricators are of the standard type adopted by the L.M.S.R. Hydrostatic lubricators are fitted experimentally, for the cylinders only, of the last five engines.

The connecting and coupling rods and the motion generally are made of high tensile manganese molybdenum steel in accordance with the latest practice. The connecting rods are fluted, as the photograph shows, but the coupling rods are not. The wheel centres are steel castings, and the wheel rims, as in the case of the "Pacific" locomotives mentioned before, are triangular in section. This gives a pleasing appearance, and at the same time affords ample strength. The tyres are secured by retaining rings of the Gibson pattern. The balance weights for the coupled wheels are built up by steel plates on both sides of the spokes, the two steel plates being riveted together. The necessary weight is provided by filling in between the plates with molten lead.

The coupled wheel axle-boxes are steel castings with pressed-in brasses having suitable white metal pockets and oil grooves provided on both sides of the crown to ensure a thorough distribution of oil to the journal. The axle-box underkeep carries an efficient oil pad that can be examined by sliding out the underkeep while the axle box is in position. The lubrication of these axle-boxes is effected by an independent mechanical oil feed to the crown of the box with the standard back pressure valve and flexible oil pipe connections.

The leading wheels run in a truck of the Bissel type. The weight on the truck is taken through side bolsters, and the side check spring gear has been carefully arranged to ensure smooth riding at both high and low speeds. *(Continued on page 248)*

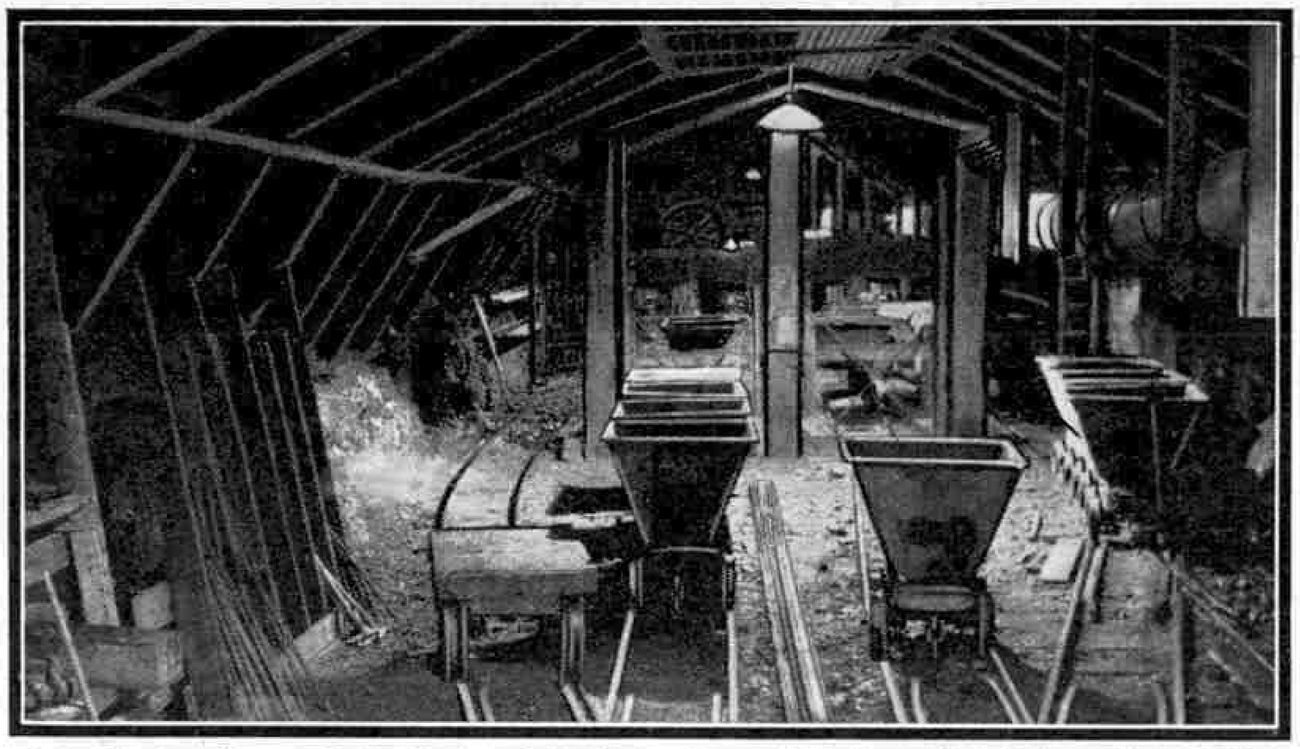
Comparative Dimensions of L.M.S.R. "Mogul" Locomotives

	New "13245" Series	Original "13000" Series
Cylinders		
Diameter	18 in.	21 in.
Stroke	28 in.	26 in.
Wheels		
Leading	3 ft. 3½ in.	3 ft. 6½ in.
Driving	5 ft. 6 in.	5 ft. 6 in.
Heating Surface		
Tubes	1,256 sq. ft.	1,361 sq. ft.
Fire-box	155 sq. ft.	160 sq. ft.
Superheater	193 sq. ft.	307 sq. ft.
Total	1,604 sq. ft.	1,828 sq. ft.
Grate Area	27.8 sq. ft.	27.5 sq. ft.
Working Pressure ...	225 lb. per sq. in.	180 lb. per sq. in.
Tractive Effort at 85 per cent. working pressure	26,288 lb.	26,580 lb.
Adhesive Weight ...	55 tons 10 cwt.	56 tons 3 cwt.
Weight of engine in working order	65 tons	66 tons
Weight of tender in working order	42 tons 4 cwt.	42 tons 4 cwt.
Total weight of engine and tender in working order	107 tons 4 cwt.	108 tons 4 cwt.
Coal capacity	5 tons	5 tons
Water capacity	3,500 gallons	3,500 gallons
Total length of engine and tender over buffers ...	59 ft. 10¾ in.	59 ft. 3⅞ in.

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

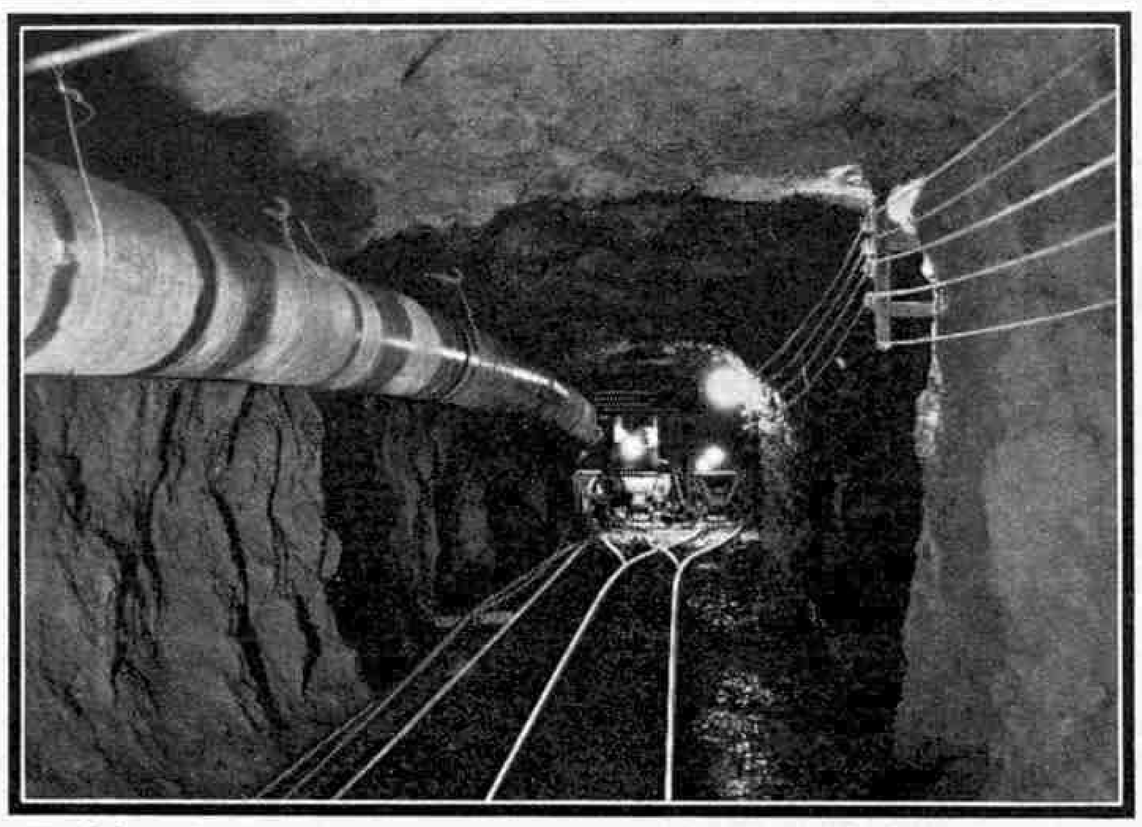
New Zealand's Second Largest Tunnel

A railway tunnel system that when finished will be the second longest in New Zealand is in course of construction near Wellington. It will consist of two sections with a combined length of 3¼ miles, and when it is completed trains from Wellington to Tawa Flat will no longer have to climb the heavy gradients now encountered. Each of the two bores is to be 19 ft. in height and 20 ft. in width, and therefore will comfortably accommodate a double track.



An underground scene in the longer of the two sections of the Tawa Flat Railway Tunnel, New Zealand's second largest tunnel, now under construction near Wellington. Photographs on this page by E. Peters, Dannevirke, New Zealand.

Working faces were started at the ends of each section, and in addition a vertical shaft was driven 137 ft. into the earth in order to intercept the line of the longer portion and to give access to two more working faces. Thus the rock is being attacked at six points. Work in the tunnels proceeds night and day. At each face what are known as "mining gangs" are excavating a drive measuring 8 ft. by 8 ft., and they are being followed by gangs of men who enlarge the bore to its full width and then line it with concrete. The necessary material for the lining is prepared in huge mixers built above one of the tunnel entrances. There trucks are loaded with concrete poured down iron chutes leading from the mixers, and are then hauled into the tunnel by powerful little electric locomotives supplied with current from accumulators. On arrival at the working face the concrete is shot by means of powerful compressed air concrete guns into timber casings built up to retain it in position until it is set.



The 8-ft. shaft of Tawa Flat Tunnel driven by "mining gangs." Other gangs follow and enlarge the drive to make it 19 ft. high and 20 ft. wide.

I found a visit to the bottom of the shaft in the middle of the larger section of the tunnel very interesting, and obtained the accompanying photographs there. An electric lift has been installed in order that trucks carrying excavated material from the two inner working faces can readily be taken to the surface. The huge compressors that supply air for the drills are near the lift head, and there are also great electrically-driven fans that keep the air in the tunnel cool and fresh.

I learned that a small underground lake was tapped while one of the headings from the bottom of the shaft was being driven. The water broke into the tunnel and several of the workers had narrow escapes from being whirled away and drowned. The tunnel afterwards was cleared of water by means of 10 electric pumps that were kept continuously in operation for two days.

The tunnel section will be electrified throughout, and important new railway works are being carried out at Wellington and at Porirua, two miles from Tawa Flat, in connection with the scheme.

At the Wellington end of the tunnel land has been reclaimed from the sea on which a goods shed has been constructed and a larger station is being erected, while a station and shunting yard are being built at Porirua.

E. PETERS (Dannevirke, N.Z.).

A Motor Trip in the Balkans

When spending a cruising holiday in the "*Stella Polaris*," a motor ship of 6,000 tons, we visited Cattaro, a port on the Dalmatian coast that is at the head of a deep fiord. The surroundings are magnificent, for rugged mountains tower above the peaceful waters of the inlet.

One day we drove to Cetinje, formerly the capital of Montenegro, and the journey proved more exciting than we had expected. We entered motors waiting for us on the quay, and then began one of the most thrilling drives I have ever had. Cetinje is on a plateau 4,000 ft. in height. Its distance in a direct line from Cattaro is only about eight miles, but the mountain road by which it is reached is so steep that nearly 30 hair-pin bends are necessary as it winds its way upward, and the drive took 2½ hours. At times we were able to shout to parties in other cars above and below us as readily as if they were on different floors of a very tall building, although by road we were half a mile or more apart. The driver seldom slowed down when approaching a corner, and whirled us round the bends in a terrifying manner; while he shot past other cars meeting us in narrow places at speeds that seemed very dangerous.

Cheerful Montenegrins in Cetinje. Photograph by L. Burdekin, Hythe.

At last we drove through a pass in the mountains and dropped down into Cetinje. A small market was in progress and the streets were full of people in picturesque dress. We tried to buy some chocolate in a little shop. We had no local money with which to pay, however, and although we offered a varied assortment of Turkish, Italian and English coins, the shopkeepers became suspicious and carefully removed their stock beyond our reach! Finally they contemptuously rejected our money, and we retreated, feeling rather foolish.

Eventually we packed ourselves into the cars again, and set out to Cattaro. We returned more quickly than we went, but the descent seemed frightfully hazardous, and the cars made so much noise that we felt deafened for some time after reaching our destination. We were relieved to find ourselves once more standing safely on the quay, but we had enjoyed an exciting and memorable day, and our safe arrival left us with nothing but admiration for the driver who had shown so much skill in negotiating difficult hair-pin bends at high speed!

L. BURDEKIN (Hythe).

A Miniature Ceylonese Road Tunnel

Many natural features of unusual interest are to be seen in touring Ceylon, and the accompanying photograph shows one of them. It is a huge overhanging mass of rock, known as Ramboda Rock, that marks the foot of a steep and long main-road climb about 12 miles in length. The rock projects over the full width of the road, on the other side of which there is an almost vertical drop of about 100 ft. to the valley below. Steel rails supported by concrete posts have been erected as a protection against accidental falls.

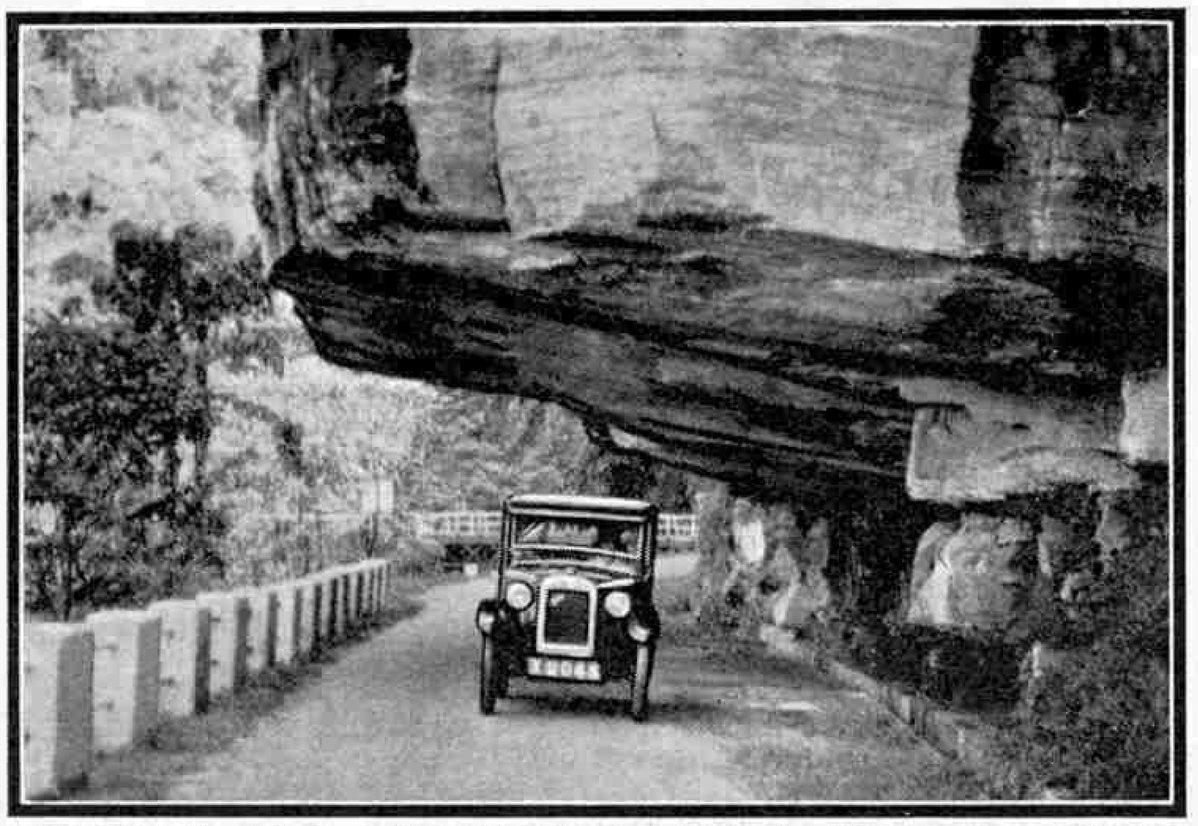
After passing under Ramboda Rock, the road ascends to the hill station of Nuwara Eliya. The scenery is very beautiful, and extensive views are obtained as the road winds round the hair-pin bends and sharp curves.

Another interesting road feature is a tiny tunnel, 10 ft. in length and 8 ft. in height, bored through a solid mass known as Kadugannawa. This is near the top of a long climb on the road to Kandy, the ancient Singhalese capital.

L. G. Loos (Ceylon).

The La Guaira and Caracas Railway

The La Guaira and Caracas railway, one of the most picturesque mountain lines in the world, connects La Guaira, the chief port of Venezuela, with Caracas, the capital. Although the distance between the two cities is only seven miles as the crow flies, so high and precipitous are the mountains between them that actually the train travels more than 23 miles in making its tortuous way from one to the other. The gradients vary from 1 in 33 to 1 in 25, and a height of 3,105 ft. is reached before the descent to Caracas begins.



Ramboda Rock, Ceylon. This overhanging mass marks the beginning of a continuous climb nearly 12 miles in length to a famous hill station. Photograph by L. G. Loos, Colombo.

The railway was completed in 1883 and until the end of 1927 it was operated by steam only. The whole track then was electrified, power being supplied by overhead wires. Wooden sleepers hold the rails in place, and what seems to be an excessive amount of ballast is used. Each train has a "cow-catcher" and three powerful headlights on the front, and a rope passes over each carriage, connecting a warning bell on the locomotive with the guard's van. The carriages are American in style, having doors at each end, and have no windows because of the great heat. Flags are employed instead of signals.

H. FROBISHER (Swaffham).

In the Zambezi Elephant Country

A Morning Hunt

By Wilfrid Robertson

THE faint chill that heralds the African dawn was in the air, and I awoke to see that Jupiter, the morning star, had just risen above the eastern horizon. Below the camp flowed the broad waters of the Zambezi, reflecting the star's bright rays; while on the other three sides stretched the illimitable forests. The glow of the camp-fires illumined the trunks and branches of the surrounding trees, intensifying the blackness behind them; and I saw that my personal native was already busy boiling the kettle for my morning tea.

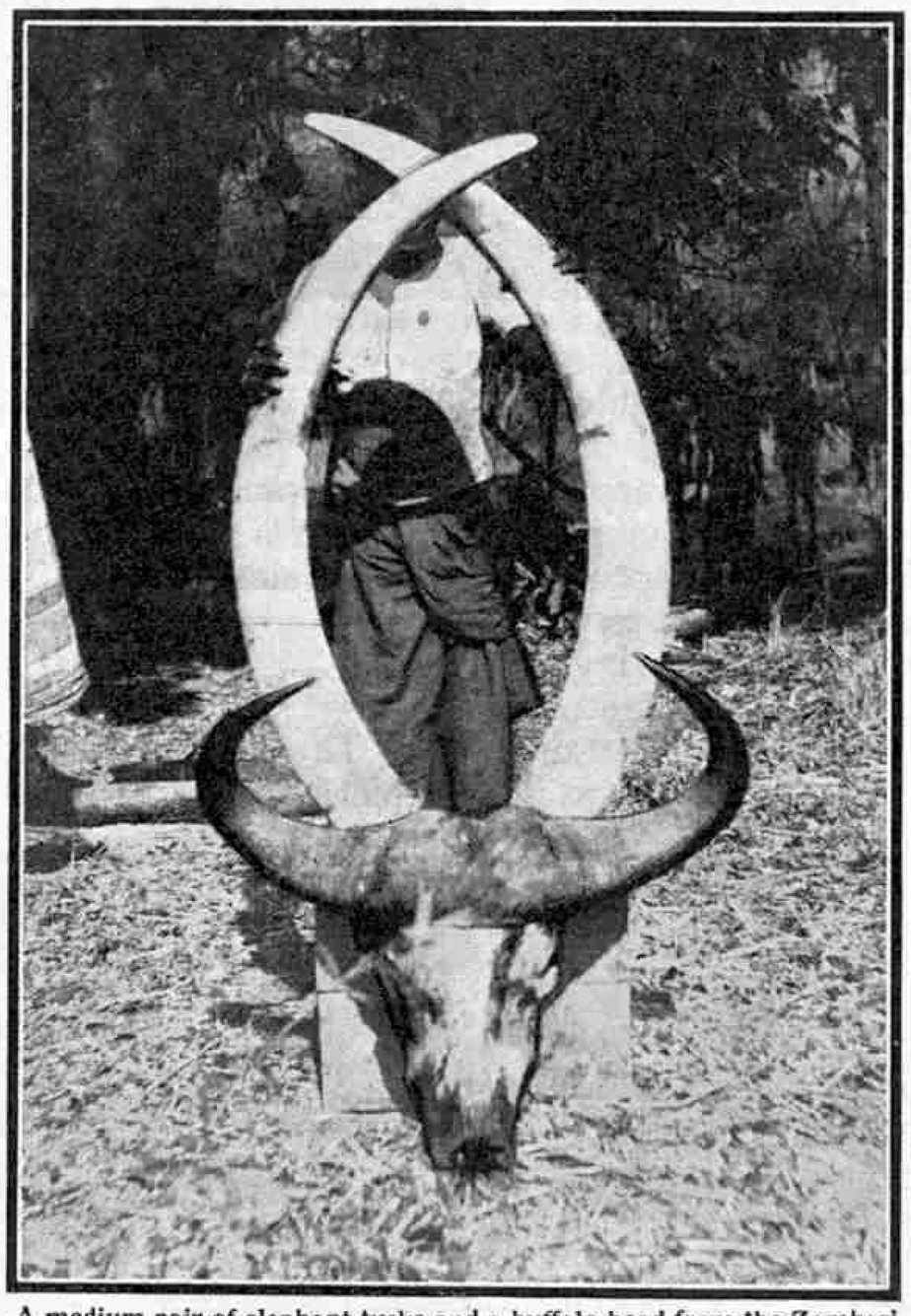
I threw aside the mosquito-net that hung above my bed upon the ground and pulled on my shirt and shorts, and while I was lacing up my boots the native came along with the steaming teapot. With the rapidity of the tropics the east lightened, and the dawn-breeze began to flutter the leaves on the tree-tops. By the time I had finished the tea there was sufficient light to "see the foresight." Picking up my heavy-bore rifle, and followed by my hunting-native, I struck out from the camp into the still dim shades of the forest.

In and out of the trees I threaded my way, my eyes alert for the first glimpse of game. Presently there was a sudden noise on my front right; a herd of impala antelope, half hidden by a mass of bushes, had sprung to life and were dashing away in a series of graceful leaps. A little farther along I saw a couple of waterbuck bulls moving among the trees, making for their daytime haunt after drinking at the river just before the dawn. But I took no heed of these animals, for I was in search of bigger game.

The sun rose clear of the distant hills, its rays catching the tops of the trees around and turning them to gold. A minute later they touched the ground, casting long shadows from the trunks across my advance, and flooding the forest aisles with brilliance. Infinitesimal motes floated in the sunbeams, and the smell of the African morning was strong in my nostrils.

From the forest 200 yards ahead echoed the sound of a breaking branch, and then another—unmistakable indications of feeding elephants. I moved forward more cautiously, keeping my eyes skinned for the first glimpse of the great beasts. And then at last I saw one of them. A bull emerged from a patch of denser forest about 60 yards ahead, and began to move across my front.

Squatting quickly down for steadiness—for few trained hunters ever fire standing—I aimed for the side of the elephant's head. The crash of the cordite split the stillness of the morning, and the great beast came down with a thud that shook the ground and sent dust and dead leaves flying upward. A moment later the animal was once more on its feet—it had been more stunned than injured—and was about to charge. I was ready, however. My other barrel took the bull between the eyes, and this time the shot went true. Striking the nostril-channel, the only vulnerable frontal shot at an African elephant's head, the bullet drove home in the brain. As the bull came down, and the reverberations of the second shot died away, I heard the receding sounds of breaking branches as the rest of the herd stampeded away through the forest.



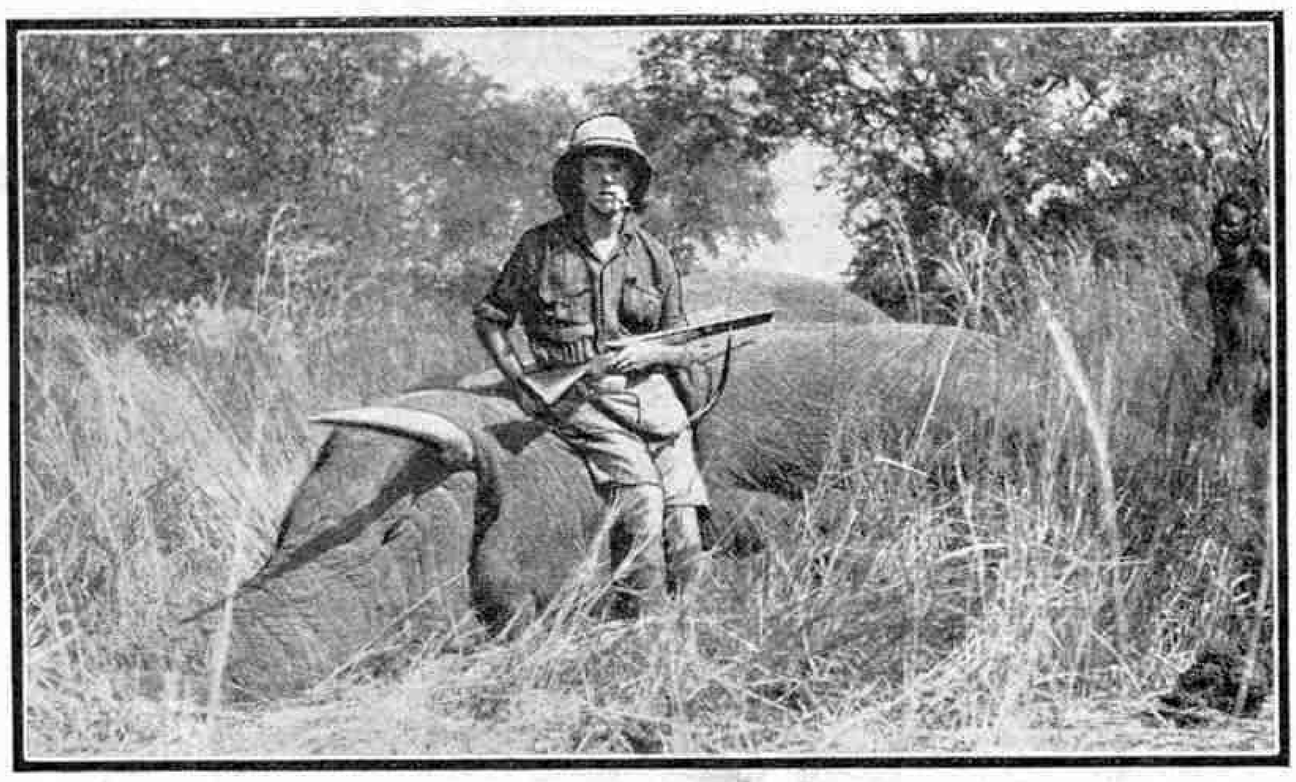
A medium pair of elephant tusks and a buffalo head from the Zambezi River country.

I walked to where the dead elephant lay, and for a few minutes stood beside the body, examining the tusks and talking to the native who had accompanied me. At length I turned away and began to retrace my steps towards the camp, my intention being to have breakfast and then return with a gang of natives for the cutting-up work.

Two hours later I approached once more the spot where lay the elephant, and behind me followed my party of retainers. On reaching the place I found that already some 30 or 40 of the local people from the villages near by had foregathered there. With the wonderful news-gathering faculty of the savage, they had heard not only that an elephant was down, but exactly where, and they had come in eager expectation of a great gorge of meat. More meat-seekers appeared from the trees before I had selected my best natives and given orders about the removal of the tusks, and by the time I gave the word to fall-to there must have been 100 waiting savages round the carcase. They needed no second bidding; the words had hardly left my lips before the elephant was hidden from sight by the eager throng.

My superintendence of the ivory-removing party was interrupted by one of the local savages who, with an envious glance at the sheath-knife I always carried

in my belt, informed me that he had no knife. I grinned and shook my head. My "bushman's friend," my companion during many years of hunting, and the product of a famous Sheffield firm, was as sharp as a razor, and I knew the condition it would be in after two minutes of native handling. "No," I responded in the local dialect, "you go and find one for yourself; the others have done so."



The author and a bull elephant.

And certainly they had; in every pink-palmed black hand among the crowd of meat-lovers appeared a crimsoned cutting-tool. Some of the men flourished clasp-knives of the type that are sold by the thousand in trading-stores for the modest sum of a shilling or its equivalent. Others were using spear-blades hastily wrenched from their sockets in the shafts; some extracted so hurriedly, indeed, that the tangs had been broken off short. They were useful tools, those spear-blades; they were long for the drawing-stroke and the soft native steel of which they were made takes a fine, though easily blunted edge. Many of the knives were more like swords, boasting hilts adorned with much fine work in patterned brass wire. Other weapons had originally been pieces of stout baling-iron, filched no doubt from the white men's distant ranches, and converted into handy double-edged slashers with handles of wood and bark-ribbon.

Sweet-barked thorn tree smashed and stripped by elephants.

But the methods of use were even more remarkable than the variety of weapon. The tools were used indiscriminately for hacking, cutting, and stabbing; edges were rapidly notched and twisted; but there could be no pause, lest "the other fellow" should secure the treasured titbit. Crimsoned blades rose and fell, only to pause in their work when the panting owners used them for threatening their rivals.

At length the tusks were extracted, each with a basal covering of bone attached, which would be removed at leisure in the camp. The ivory was carried clear of the throng round the carcase, and laid beneath a tree. There was no further need for me to remain on the spot; the sun had reached its zenith, and there was cool shade at my bivouac. After beckoning to my natives to pick up the ivory and follow me, I struck out for my temporary home, leaving the rest of the savages to fight themselves to a standstill over the division of the meat.

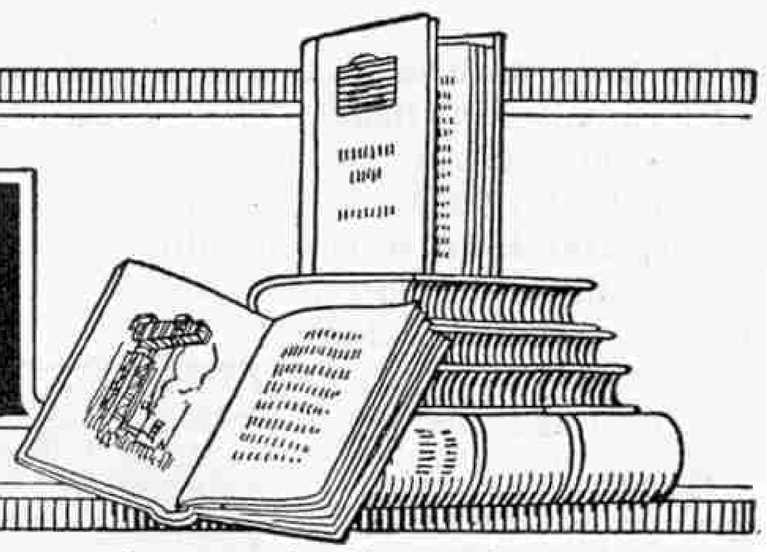
My journey back to camp, beneath the vertical rays of the mid-day sun, might have been through a different world from that traversed in the light of the dawn. Instead of the cool and mysterious forest, full of odd shadows, and slashed horizontally by the golden rays of the newly-risen light, everything seemed hard and rigid as if it had been cut from cardboard. Beneath each tree lay its clump of inky shadow, its edges as sharply defined as a pool of spilt tar; and the whole world seemed to wilt beneath the torrid vertical beams.

The bush was empty of life. The many different kinds of animals and birds that I had seen moving among the trees at dawn had vanished utterly from sight; every creature was lying-up in some cool and shady retreat during the hours of heat. Even the breeze that rustled the tree-tops seemed without vitality, and the only living things I saw were a couple of eagles sailing slowly and on motionless wings high against the brazen blue. Not until eventide would the world of nature awaken again to life.

The deep green of the trees that shaded the camp came in sight, the foliage interlaced with spirals of thin smoke from the smouldering camp-fires. Beyond, dotted with vivid yellow sandbanks and reed-covered islands, shimmered the purple-blue waters of the broad Zambezi; while far in the distance, looking like low clouds in the heat-haze, rose the outlines of distant mountains. It was a picture full of colour, of those primary tints that would look startling and bizarre in any painting save one drawn by the Great Artist. It is in colour more than anything, perhaps, that lies the fascination of the tropics, in those shades that are so strongly enhanced by sunlight of a glaring brilliance such as is never seen in these cold northern isles of Britain.

As I neared the camping-ground a figure rose from beside one of the fires; it was that of my cook-boy who had been left to guard the place while every other native was away at work on the elephant. Much as he had wanted to come too, he had resigned himself stoically to being left, realising the necessity. Upon hearing my steps he lifted the boiling kettle from the fire and reached for my teapot; he knew that I should need a drink after my tramp in the hot sun. Striding in beneath the shade of the clump of arching trees, I laid my rifle in its accustomed place and cast myself down on my blankets. Another Zambezian morning was over.

Books to Read



Here we review books of interest and of use to readers of the "M.M." We can supply copies of these books to readers who cannot obtain them through the usual channels. Order from Book Dept., Meccano Limited, Binns Road, Liverpool 13, adding 1/- for postage to the price. Postage on different books vary, but any balance remaining will be refunded.

"The Romance of Treasure Trove"

By R. Beard. (Sampson Low. 10/6)

In his immortal "*Adventures of Tom Sawyer*" Mark Twain tells us that "there comes a time in every rightly constructed boy's life when he has a raging desire to go somewhere and dig for hidden treasure." As the author of this book points out in his preface, "Life to-day will not permit that any but the favoured few can follow this urge. For those unfortunate others this book has been written that they may have their adventures vicariously."

It is seldom that treasure has been discovered by means of organised search, for nearly all expeditions end in disappointment and failure. On the other hand, the chance turn of a spade, or the turn of a plough, has laid bare treasures of inestimable worth. There is a great store of material (much of it is found in folk lore and tradition) relating to treasure trove, and on this store Mr. Beard has drawn to form the basis of his fine book, which is described by an authority as the most comprehensive book on the subject that has been brought together. Not only are the finds described, but also their discoverers and the methods used in searching, and we come to the inevitable result that, indeed, "truth is stranger than fiction."

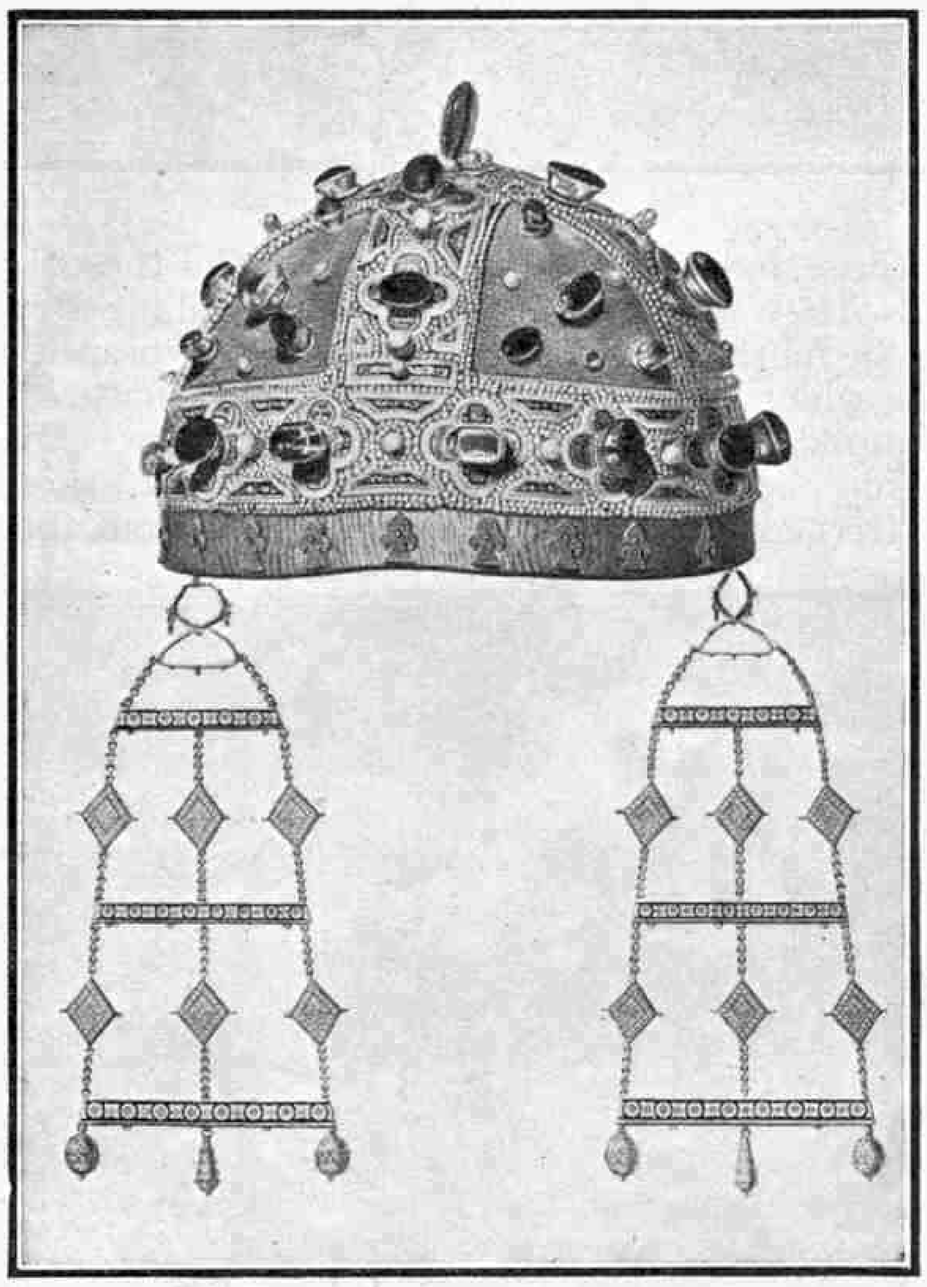
As Mr. Ronald Coates, F.S.A., points out in his introduction, "the lure of treasure trove has had a definite influence on history throughout the centuries. . . . In besieging the castle of Châlus in 1199, Richard Coeur de Lion was engaged in a treasure hunt on a grand scale. The reported treasure was immense and the King employed his army to reduce the Castle and obtain the gold, only to receive his last wound and die unenriched. Again it was almost certainly the lure of a pitcher full of foreign gold coins that enabled Alexander Ruthven in 1600 to entice James VI to the home of his brother the Earl of Gowrie at Perth, where James nearly met his end, and both the Earl and his brother were slain."

A glance at the contents list convinces us that the book is certainly full of romance. There are chapters on treasure hunting in the Middle Ages; ghosts, and dreams about treasure; early treasure hunters, treasures of old Rome; lost crowns; the treasures of the tomb; coins; treasures of the Church; of the civil war; and of "Old London"; the lost treasure of Israel, and some treasures yet to be discovered.

Among legendary treasures Mr. Beard includes that of King John, whose treasure is supposed to have been lost in the waters of the Wash. Attention has been called to it recently by the forming of an expedition to attempt to recover it by scientific methods. From what Mr. Beard says on the subject, however, it would appear that the seekers will meet with little success. He describes this lost treasure as "the greatest mare's nest treasure of history," and assures us that King John's treasure, his entire Regalia, and money chests were never lost, and probably were never even wetted in the waters of the Wash at all. He thinks "it is high time that the schoolroom fable that John's Crown was swallowed up into the quicksands of the Welland should be cast into the dustbin which is reserved for the shards of all shattered legends." He points out that on the face of it "the story looks like one of those jokes of which Gilbert a'Beckett was so inordinately fond. . . . In his '*Comic History of England*' he confined himself to the but slightly inaccurate statement that although John himself escaped disaster 'his horses with his plate, linen, and money, were not so fortunate for he had the mortification of seeing all his clothes lost in the Wash.'" From the fact that Henry III, when crowned at Gloucester on the 28th October, 1216, was invested not with his father's crown but with a plain circlet of gold, other would-be treasure hunters have romantically deduced that it was because the kingdom's diadem had been lost by John according to legend. The fact is, however, that as at this time the whole country was in a state of turmoil, there would have been the gravest danger in removing the Regalia from the late King's stronghold in the Isle of Purbeck where it had been deposited in the July preceding.

Mr. Beard has gone very exhaustively into the subject, even to the extent of examining the King's movements day by day during his last marches. For instance, he does not find that King John travelled along the coast of the Wash at all, but well inland by way of Wisbech where he spent a night and transacted business, as is seen from the Close and Patent Rolls. Certainly on reading his book no one would be tempted to join in the present enterprise in the endeavour to locate the lost treasure! That John's baggage may have been lost between Cross Keys and Long Sutton Mr. Beard does not deny, but if the relics are ever found he is sure that they will prove to consist of camp utensils, tents, and munitions of war, together with plunder from the Isle of Axholme and the Abbey of Croyland, and the spoils from the devastated lands of the Norfolk and Suffolk barons.

Altogether the romantic subject has given Mr. Beard an opportunity of making a fascinatingly interesting book.



The Crown of the Empress Costanza. (From the book "The Romance of Treasure Trove" reviewed on this page.)

"The Treasure of San Jacinto"

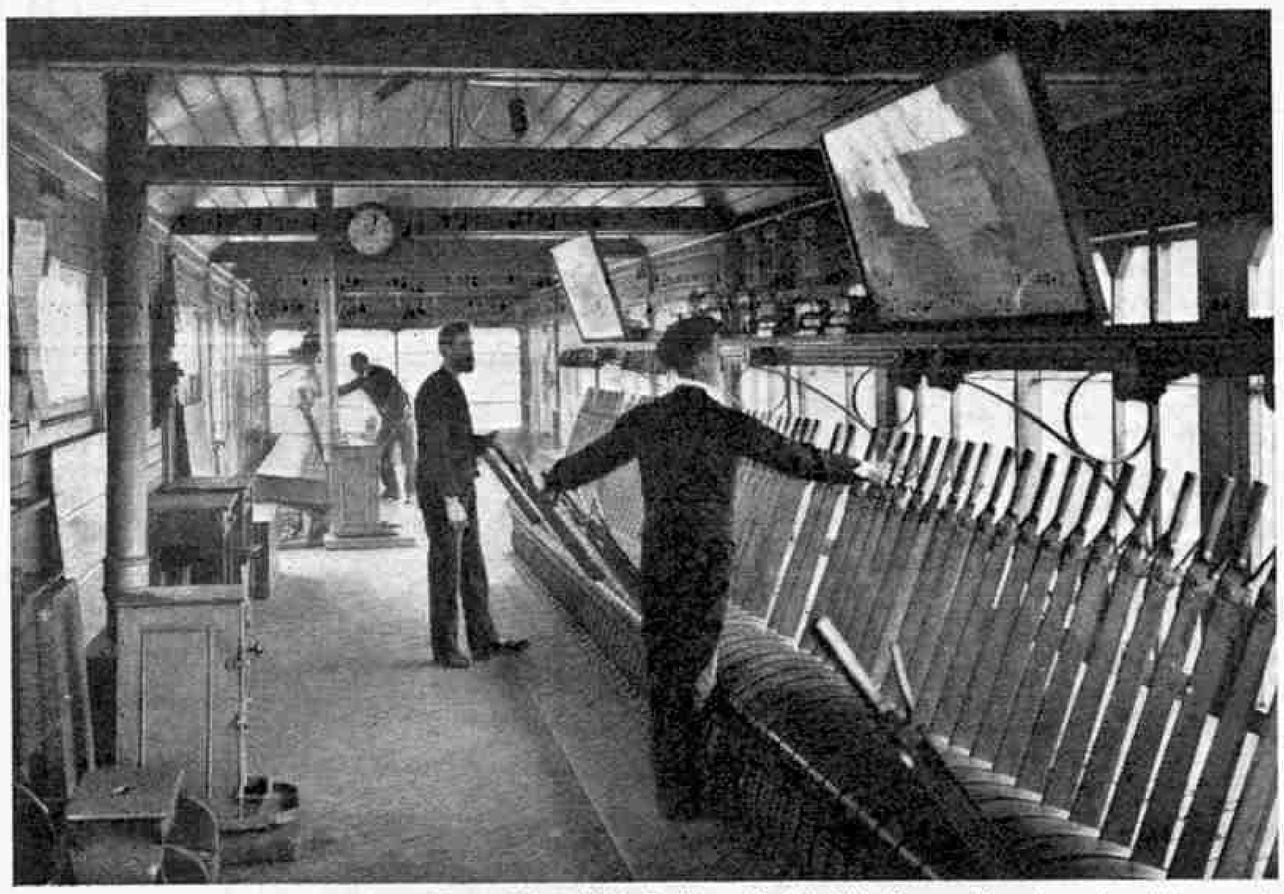
By Frank Riley. (Nelson & Sons Ltd. 3/6 net)

Most hidden treasure stories centre round an island somewhere in the middle of the Pacific Ocean, and a scrap of faded chart roughly prepared by some old sea-dog. The treasure of San Jacinto, however, takes us into the wilds of the mountains of South America.

John Elliott, while travelling in the Andes, witnesses the murder of a man by the notorious brigand chief Cabrera. Elliott rushes to pick up the man who, just before he expires, manages to stammer out a few words that give a vague clue to the position of a treasure supposed to have been buried more than a century earlier by a community of monks before they were expelled from the country by the Spanish authorities. In the course of his subsequent wanderings in the mountains Elliott comes across a place that seems vaguely familiar, and suddenly it flashes across his mind that the scene fits in almost exactly with the dying man's half incoherent words. He then and there determines to return to England as soon as possible and equip an expedition to search for the treasure.

Derek and Geoffrey Millington, who are chafing against the dull monotony of work in the office of their uncle, a solicitor, have the great good fortune to be allowed to accompany Elliott and his tall American friend Harry Persson on the treasure hunt,

and the story is concerned with the stirring adventures that befall the party from the time when they land at Callao. After successfully transporting their mining machinery and equipment up into the mountains to the place where the treasure is believed to be hidden, the party settle down to serious excavation work. For a time their progress is slow and disappointing. Some silver is found, but there is no sign of the legendary treasure; and the party are almost beginning to doubt its existence when matters are livened up by the arrival of the bandit Cabrera and his men. Fighting now takes the place of digging, and it is real fighting, with bullet, knife and dynamite, thrilling incidents following fast one upon another. There is no harm in saying that the brigands are defeated, but to tell how the treasure was ultimately found would be to spoil a thoroughly exciting and well-written story.



Manually-worked signal-cabin. (From "A British Railway Behind the Scenes" reviewed on this page.)

"A British Railway Behind the Scenes"

By J. W. WILLIAMSON, B.Sc. (Benn. 5/-)

The author's purpose in this book is to give, as far as possible, a picture of the functioning of a railway system, so that the reader may understand something of the organization as a whole. It is not a technical volume for railway experts and workers, nor on the other hand is it merely an attempt to explain to the layman technical things in non-technical language. Written by a student of industry, it shows his view of the working of a great railway company in something the same way as a biologist looks at a living organism. He studies its component parts and the mutual relations of those parts, learning the how and why of the organization, of its productive process, and of its methods of operation. The particular railway (the London Midland and Scottish) was selected because it is not only Britain's greatest single railway corporation, but is —besides being a great organization for transport by rail, road, and sea—also a great producing concern, having many large engineering works.

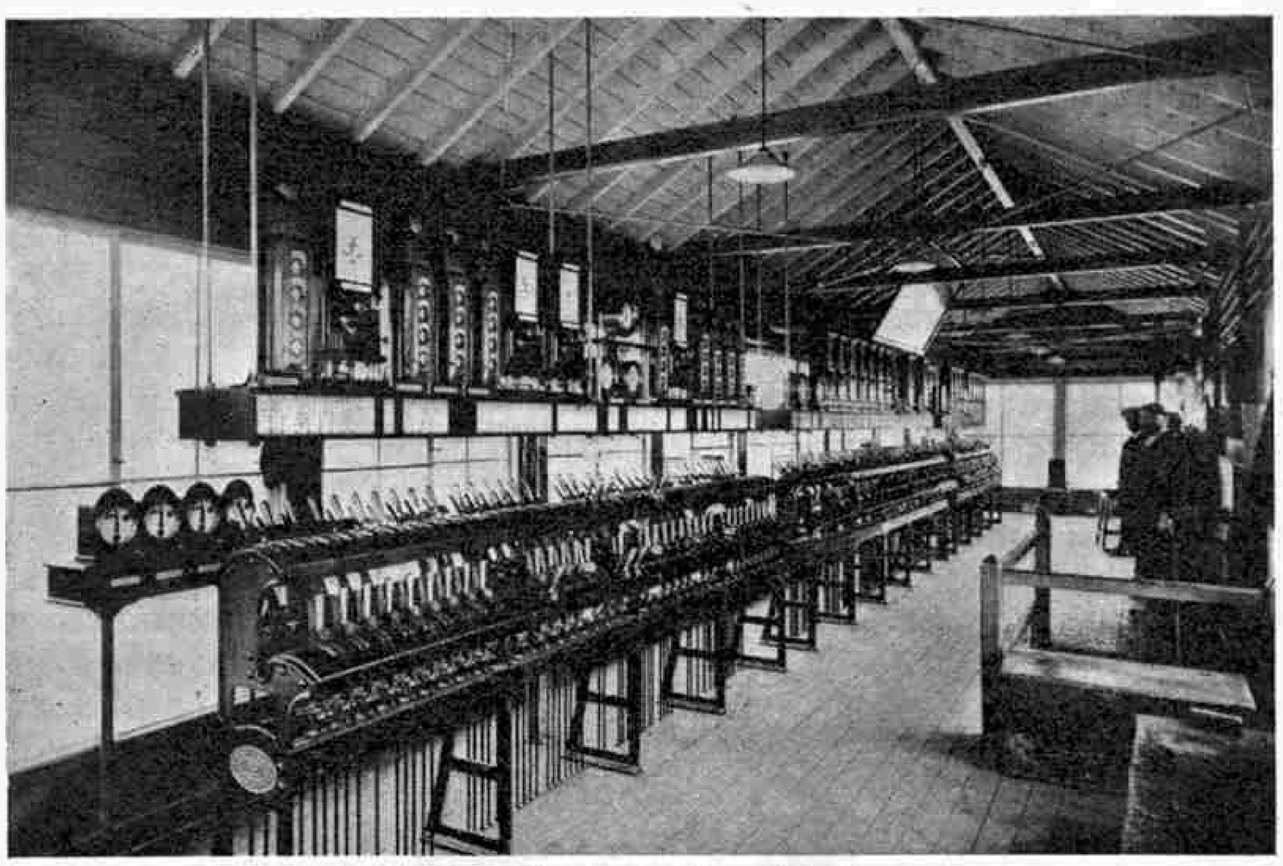
The book is divided into thirteen chapters and these cover the design, building, and repair of locomotives, carriages and wagons; the permanent way; signalling; the operation and control of passenger trains and freight trains; electric traction; organization; costing; and scientific research.

In the search for greater economies, we have many interesting sidelights on the way in which science can help industry. For instance, on the question of the investigation of paints suitable for rolling stock. The two main factors that determine the need for major repairs to carriages are the condition of the paint and the wear on the tyres. Research having shown that the use of higher grade paints did not afford any marked increase in durability as compared with the definitely increased cost, investigations were directed to improving the methods of cleaning the paintwork. There were in operation two systems of cleaning carriages—water washing and oil cleaning. In the former method an acid solution was applied at intervals of about three weeks, the paintwork being washed with water only in the intervening time. In oil cleaning the paint was cleaned with oil periodically, and dry wiped at intermediate times. Experiments were carried out at the paint and varnish laboratories at Derby, with a view to discovering a waxing composition that would combine the properties of a cleanser and a preservative. Over 250 mixtures were prepared and examined, and finally a combination of oil cleaning and water washing was tested in practice. The results were so satisfactory that the method is now in extensive operation throughout the whole system. This has resulted not only in a better appearance of the carriages being maintained at a lower cost, but in reducing the number of coats of paint from seventeen to eleven, this again resulting in a reduction of 30 per cent. in the time needed for painting. "It is not yet possible to estimate the increased time between 'shopping' of carriages that will result from the better preservation of the paint by this new method, but it is worth notice that to lengthen the overhaul period by only 10 per cent. would save £72,000 annually in repair expenditure."

This is only one of the many problems that have been solved by applying systematic scientific research in the construction, operation, and maintenance of a modern railway, all of which are equally interesting.

The book is one that we can readily recommend to all who are interested in railway operation and practice, not only from the industrial standpoint, but also from the point of view that all railway matters are interesting. It includes much information not found in other railway books and not readily accessible to the general reader.

The illustrations are particularly good, and have been well selected to cover practically all the chief subjects dealt with. Particularly interesting are those showing workshop operations in progress, such as the process of balancing locomotive driving wheels in a special machine; and among others of an unusual nature may be mentioned one showing a portion of a typical train diagram that illustrates graphically the paths of trains, and the stations, gradients and other features of a section of line.



An all-electric signal-cabin. (See above.)

List of New Books

The undermentioned books, recently published, will be reviewed in a future issue.

SEA SCOUT BADGE BOOK
(Brown, Son & Ferguson Ltd., 2/-)

THE INCREDIBLE ADVENTURES OF PROF. BRANESTAWM
by Norman Hunter
(The Bodley Head, 6/-)

A JUNGLE SCRAP BOOK
by Vera Barclay
(Brown, Son & Ferguson Ltd., 1/6)

THE ROMANCE OF MOTORING
by T. C. Bridges and H. H. Tiltman (G. G. Harrap & Co., 7/6)

ROBINSON CRUSOE
by Frank C. Pape
(The Bodley Head, 2/6)

LORNA DOONE
by Frank C. Pape
(The Bodley Head, 2/6)

THE BOOK OF SCIENTIFIC DISCOVERY
by Dr. D. M. Turner (Harrap, 7/6)

THE WHIPSNADE ANIMAL BOOK FOR CHILDREN AND OTHERS
by Helen Sidebotham and John R. Skeaping (V. Gollancz Ltd., 6/-)

LIFE IN THE WILDS OF NORTHERN TRANSVAAL
by A. Havenga (Arthur H. Stockwell, 3/6)

RECRUITS IN THE UGANDA SECRET SERVICE
by E. W. Prangley (Arthur H. Stockwell, 2/6)

WHERE AWAY?
by Harrison Dale (Herbert Jenkins Ltd., 6/-)

THE OUT OF DOORS BOOK
by Arthur Stanley (Dent, 6/-)

EVERY BOY'S BOOK OF ELECTRICITY
(Percival Marshall, 1/-)

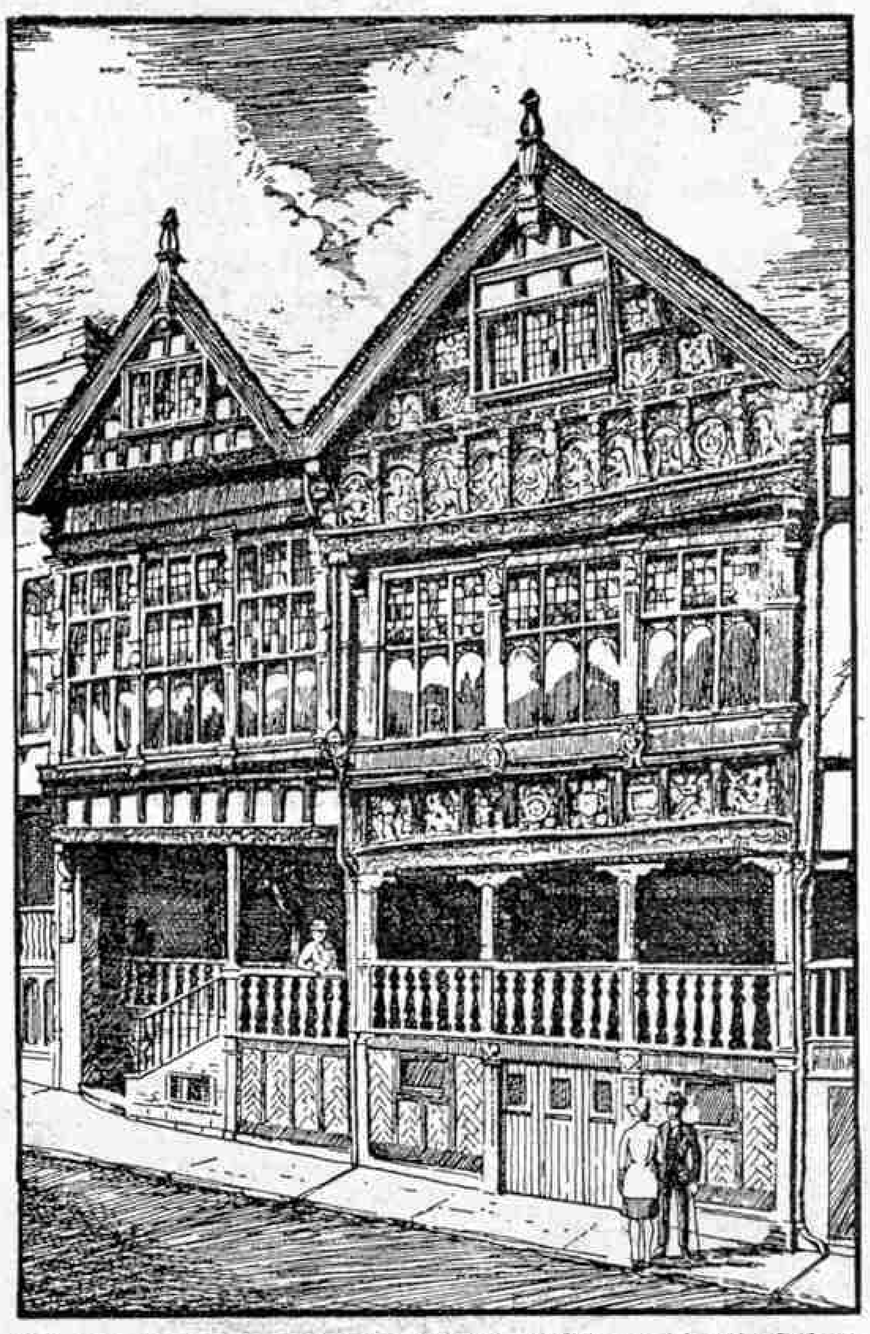
FIRST OVER EVEREST
(The Bodley Head, 12/6)

The Art of Drawing

A Chester Railwayman's Fine Work

THE art of drawing provides a fascinating study for those who would trace its romantic advance through the ages. It is impossible to estimate the extent of the debt we owe to the genius of artists throughout the centuries for so many of the amenities of life as we live it to-day. It should be remembered that, but for those who have recorded the customs, manners, modes of living, and progress of the successive periods, we should have lost many of the benefits of the experience of our predecessors.

The earliest existing examples of such work date back, it is believed, 30,000 years to the Cro-Magnard period, when figures were scratched on smooth walls of caves and smooth rock surfaces. Through the advancing civilisations of Sumeria, Egypt, Greece, Rome, India and China, records in the form of drawings have remained to give us an indication of life in those early days, and incidentally to place in chronological sequence the development of mankind. We find that these early artists laboriously executed their drawings in marble, stone, clay—later hardened by heat—and, in Egypt, with paint on papyrus scrolls. The arts they mastered spread by imitation and were developed gradually.



Mr. Boyd's drawing of the exterior of Bishop Lloyd's Palace, Chester. Illustrations by courtesy of the "Great Western Railway Magazine."

It is a far cry from such materials as those mentioned to the materials at the disposal of the modern artist, and the comparatively easy manipulation of present-day equipment and the mechanical reproduction of artists' work has had much to do with the development of public interest in, and appreciation of, the creative and reflective efforts of the artistic fraternity.

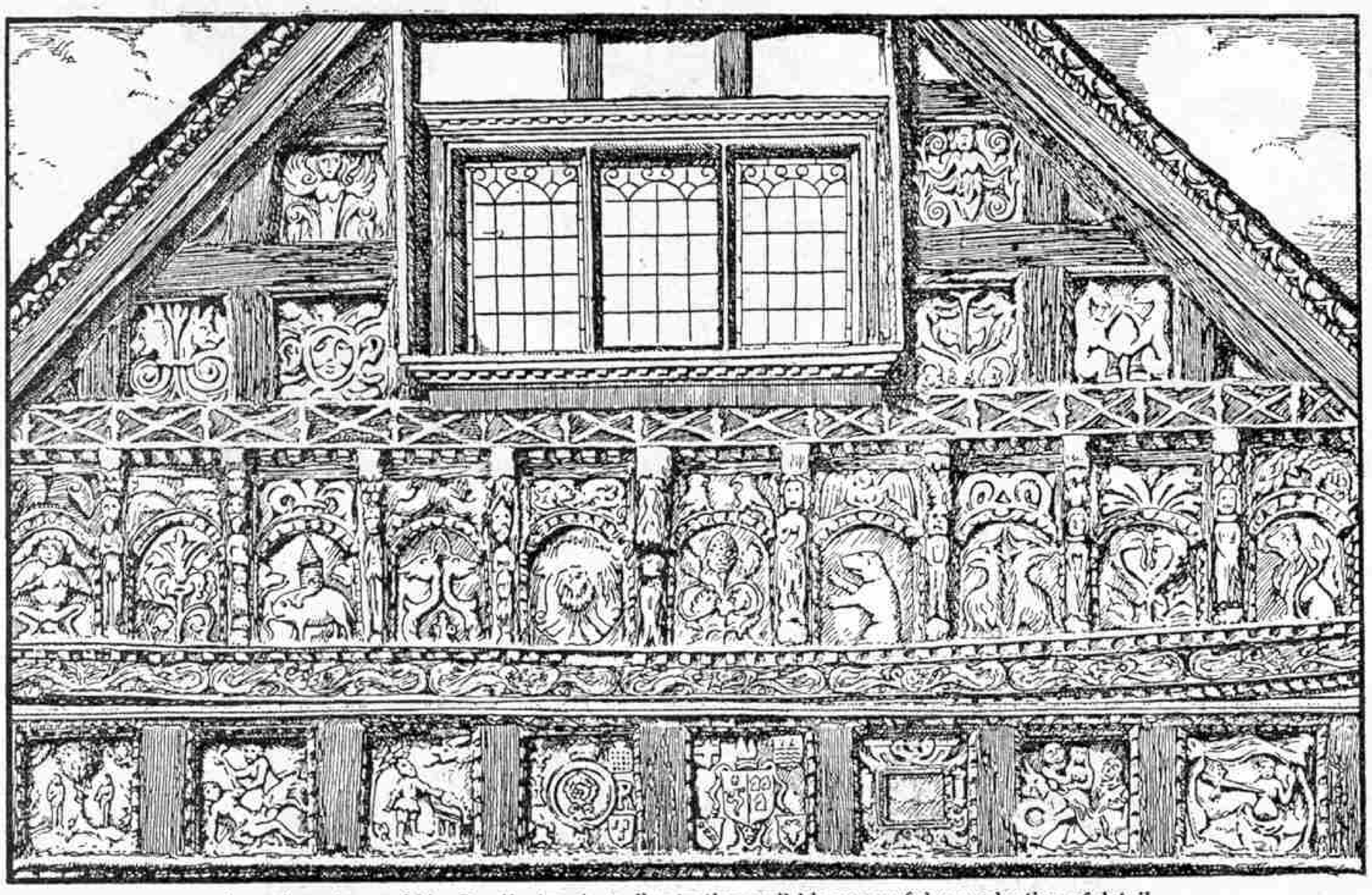
To-day, the work of the artist evidences itself on every hand—in our buildings, transport, pictures, clothes, amusements, and even our food, or at least in the presentation of it. Art has been described as "a mysterious power of creation that springs from the inner life of man," and the artistic merit of an article reflects the enthusiasm and sincerity with which its originator set about its production. Artistic ability is inherent in many, although highly developed in relatively few. Drawing affords a means of expressing emotion and visual reaction, in addition to being a pleasurable, and in some cases a profitable pursuit. Dabbling in art in an amateurish way does not need outstanding talent, and will provide many hours of interest, in addition to being educative. Furthermore, a commencement can be made at practically any age, and it is surprising how many cases there are on record of really successful artists whose ability has not asserted itself until late in life. An interesting recent example is provided by Mr. W. R. Boyd of Chester, reproductions of whose work accompany this article. Here is an artist, employed as a caller-off by the Great Western Railway, whose artistic talent was latent until middle age, when he blossomed forth as a black and white artist of no mean ability.

Mr. Boyd is entirely self taught, and although apparently he was always outstanding for his painstaking efforts in map drawing and similar work at school, he did not give serious thought to original drawings at that time, and only indulged in copying sketches on infrequent occasions. Not until he was 45 years of age did he commence to produce original work. During the latter part of the Great War he was an instructor of artillery drivers, and he found his sketching ability a great help in lectures and demonstrations to the trainees under his tuition.

After war service Mr. Boyd returned to Chester, and the charm of the architectural gems for which this old city is so famous seems to have aroused in him the desire to study and reproduce them. As time went on he learned to love the old stone and timber, and the history that they enshrined, and he set to work to reproduce with pen and ink favourite bits in architecture. Examination of our illustrations will show how successful his efforts have been. The wealth of detail in them is truly remarkable, although the bold manner in which solid white has been used in contrast means much to the strength and "atmosphere" that is so definitely portrayed. All Mr. Boyd's pictures are drawn in pen and ink, of which technique he is definitely a master.

Mr. W. R. Boyd.

As a caller-off in the service of the Great Western Railway, his late turn of duty has given him a good opportunity for a few hours work in the early morning. Wrapped up in his hobby, he has taken the fullest advantage of his leisure time. "Up with the lark" on summer mornings, he settles down to his studies in the Cathedral Close, or some



A portion of one of Mr. Boyd's drawings, illustrating well his successful reproduction of detail.

other of his favourite haunts in Chester, and as might be expected, his annual holiday is also devoted to his art.

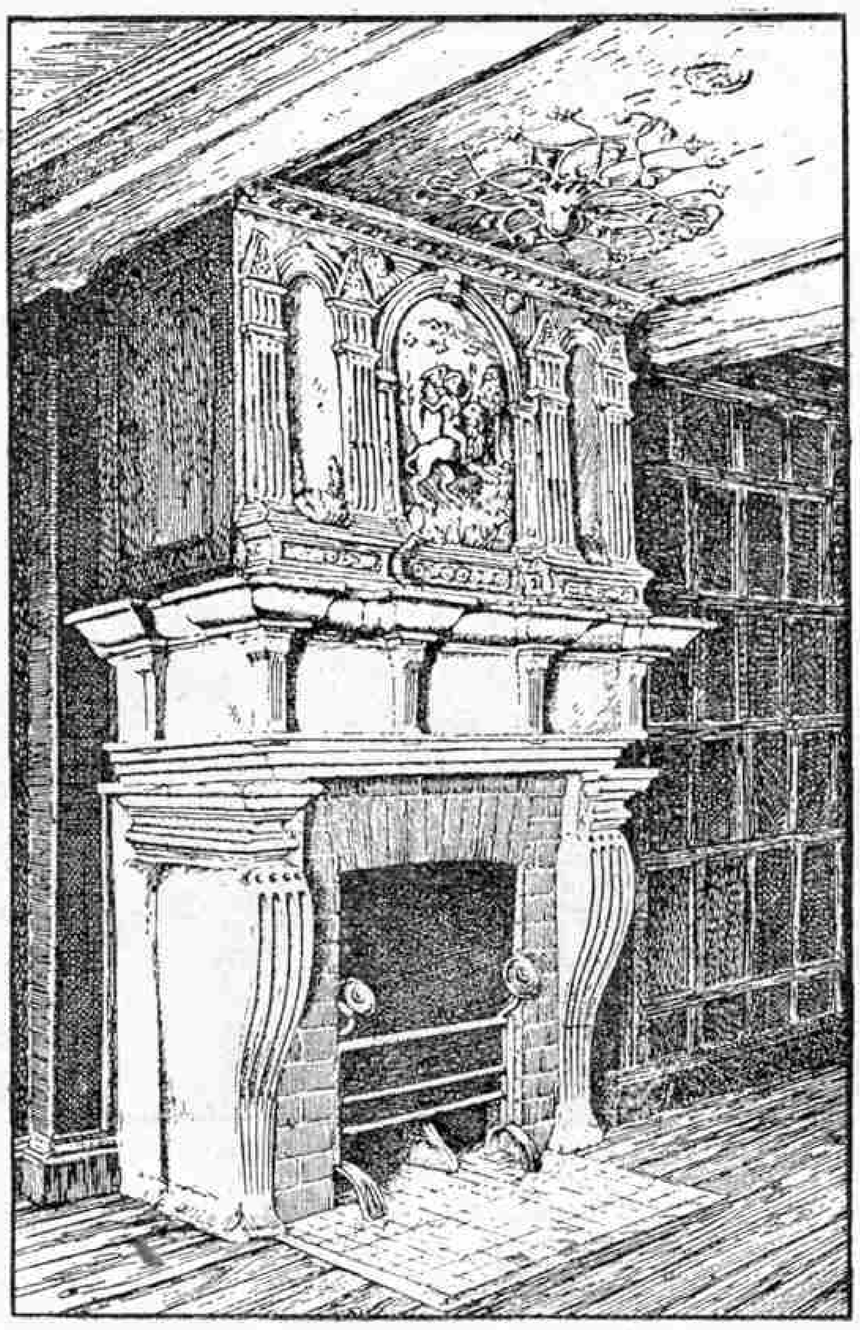
A remarkable feature of Mr. Boyd's work, which will readily be observed, is the very delicate touch that is apparent throughout. This is surprising in view of the fact that he is engaged in daily labour of the heavy manual type. As will be easily understood, his work is in regular demand. His drawings are to be found in many parts of the Empire, and several have been sent to the United States of America. It is interesting to note that a series of studies by Mr. Boyd is to be included in a comprehensive "Survey of Chester." He is a regular exhibitor at the Great Western Railway Arts and Crafts Exhibitions, and his awards include silver medals, the highest award in the black and white class, and certificates of merit.

What Mr. Boyd has accomplished should inspire and encourage youthful aspirants. There is no denying that courage and the capacity for taking pains will carry an artistic enthusiast far along the road to achievement, and at the same time provide him with a satisfying hobby that will bear comparison with any. A start can be made in quite a small way with limited material, and as time goes on, and the work improves, it is quite possible that sales may be effected with which better equipment can be purchased.

It is certain that among the many readers of the *"M.M."* there is a large number capable with pen and pencil, some sufficiently so to enable them to take up art as a career. They will have read with interest the "What shall I be?" article in the February 1933 issue, dealing with the prospects of the artistic boy. As shown in that issue, the term "artistic career" is expansive, covering a varied field ranging from portrait and landscape painting to industrial designing. The development of industry has opened up many new avenues to boys artistically minded, and careers in this branch will be found of absorbing interest, offering great scope for zeal and ability.

Commercial art embodies interior decoration, textile designing, poster and advertisement work, and fashion drawing. Artistic crafts are many, including metal work, wood carving, leather work, stained glass work, and designing of jewellery. On the lighter side there is cartooning, drawing for comic strip, and children's story books, book illustration, and theatre poster designing.

It will be seen that there is plenty of choice, and it is desirable to become a specialist in one line to achieve any distinction.

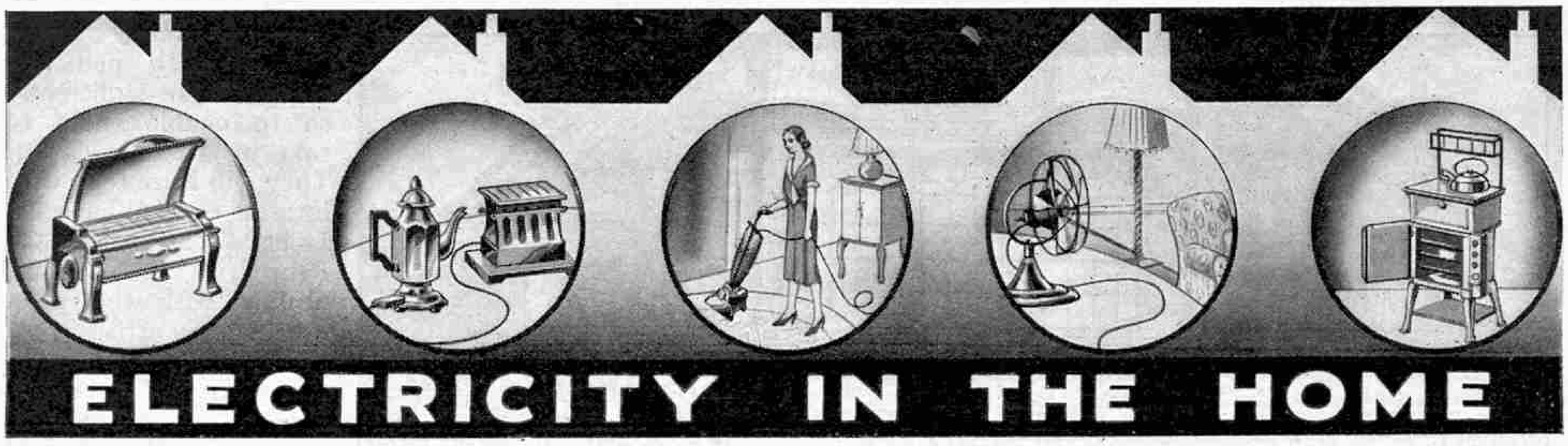


A Fireplace in Bishop Lloyd's Palace.

The majority of our readers will regard their sketching abilities in the light of a hobby, however, and in an early issue we hope to publish an article offering advice to young artists interested primarily in drawing as a pleasurable pursuit. We intend to cover the early groundwork, giving helpful suggestions as to sources of inspiration, materials to use and methods to employ. In this manner we shall probably be able to save intending artists unnecessary waste of time, and exhaustion of patience. Although it has been truthfully said there is no short cut to success in art, there is a wealth of hints and information available that is the outcome of the experience of successful artists, and is invaluable to beginners.

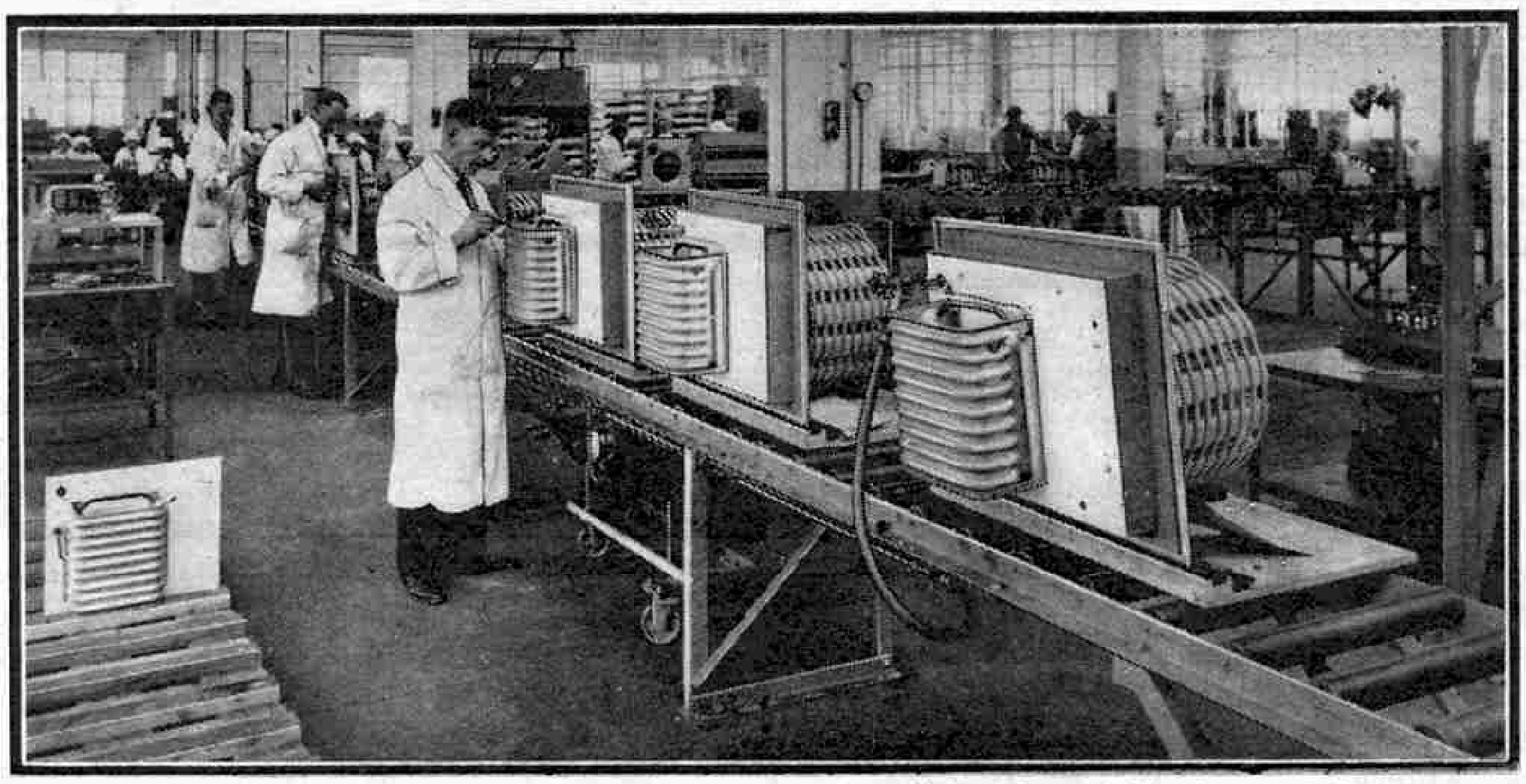
In whichever branch of art a student is interested, enthusiasm is one of his greatest assets. It carries him on and helps him to overcome obstacles with which all are beset at times.

For our information regarding Mr. Boyd's career we are indebted to the courtesy of the *"Great Western Railway Magazine."*



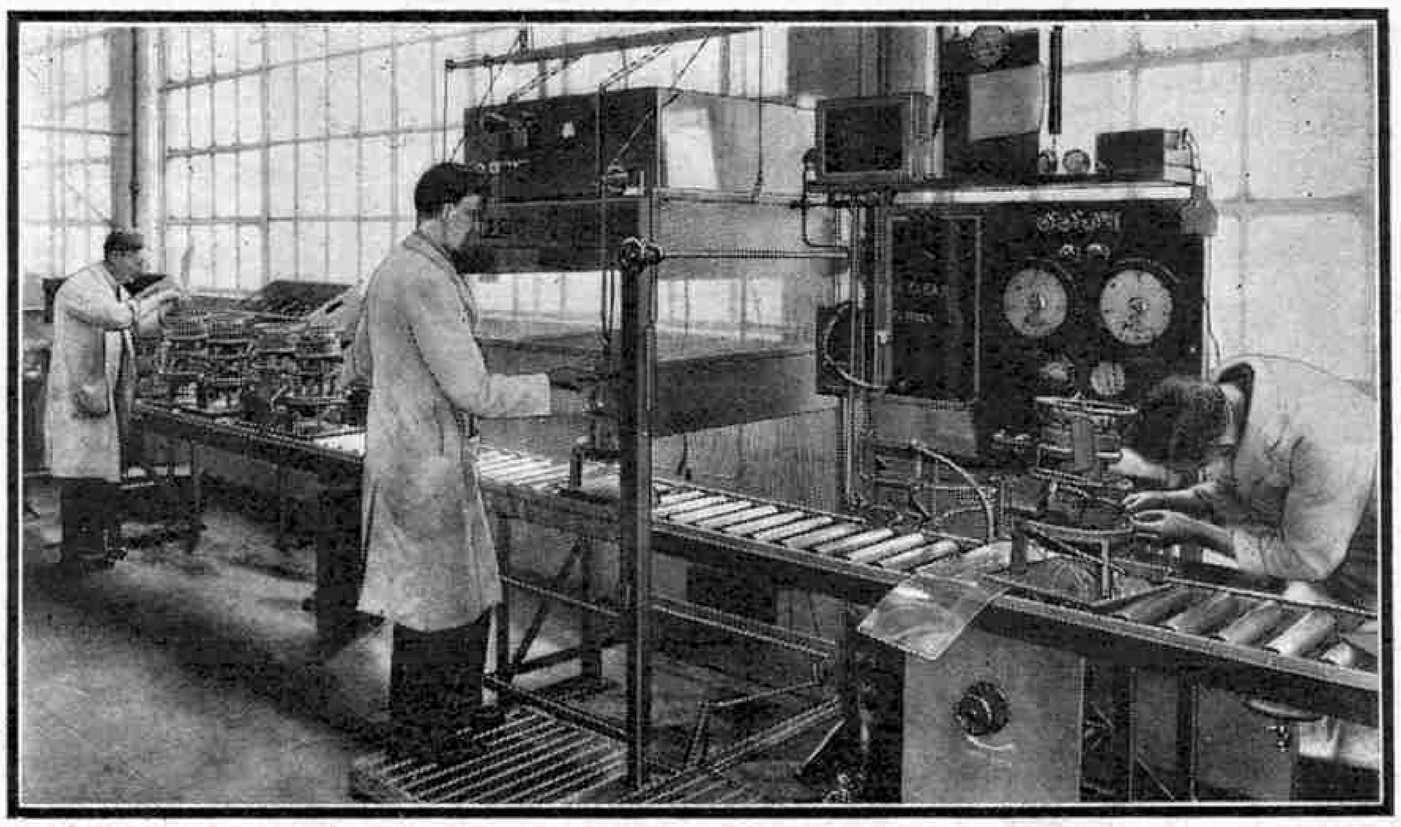
III.—MOTOR-DRIVEN APPLIANCES

IN the two previous articles in this series we explained how electricity has been utilised to provide light and heat in the home. Many other domestic applications of electricity have been discovered during recent years, and power mains are now installed in an increasingly large proportion of private houses, not only to enable heaters and cookers to be run efficiently and economically, but also to drive small motors that are put to a variety of interesting uses. The all-electric home can now be fitted with electric vacuum cleaners, washers and refrigerators; clocks and gramophone turntables can be driven by electric motors of special design; and sewing machines and many other simple household appliances can be brought into action by the turn of a switch.



The freezing units of "BTH" electrical refrigerators being fitted in position. We are indebted to the British Thomson-Houston Co. Ltd. for the photographs illustrating this article.

One of the most familiar appliances making use of a small electric motor is the vacuum cleaner, which is now marketed in many different forms. In this an electric motor drives a powerful fan that draws air at high speed through suction pipes leading from the nozzles and brushes employed in sweeping. The air stream carries with it dust and dirt, and this is retained in some form of filter, usually consisting of a bag of closely woven textile material, through which the air passes freely. The many types of cleaner now in use are provided with special attachments to enable walls and stairs to be swept and corners to be thoroughly cleaned out. In one interesting application the vacuum cleaner is used as a disinfector, the stream of air produced by the fan passing through a chamber containing a deodoriser before being exhausted into the room, or driven by means of a special nozzle under carpets or other coverings.



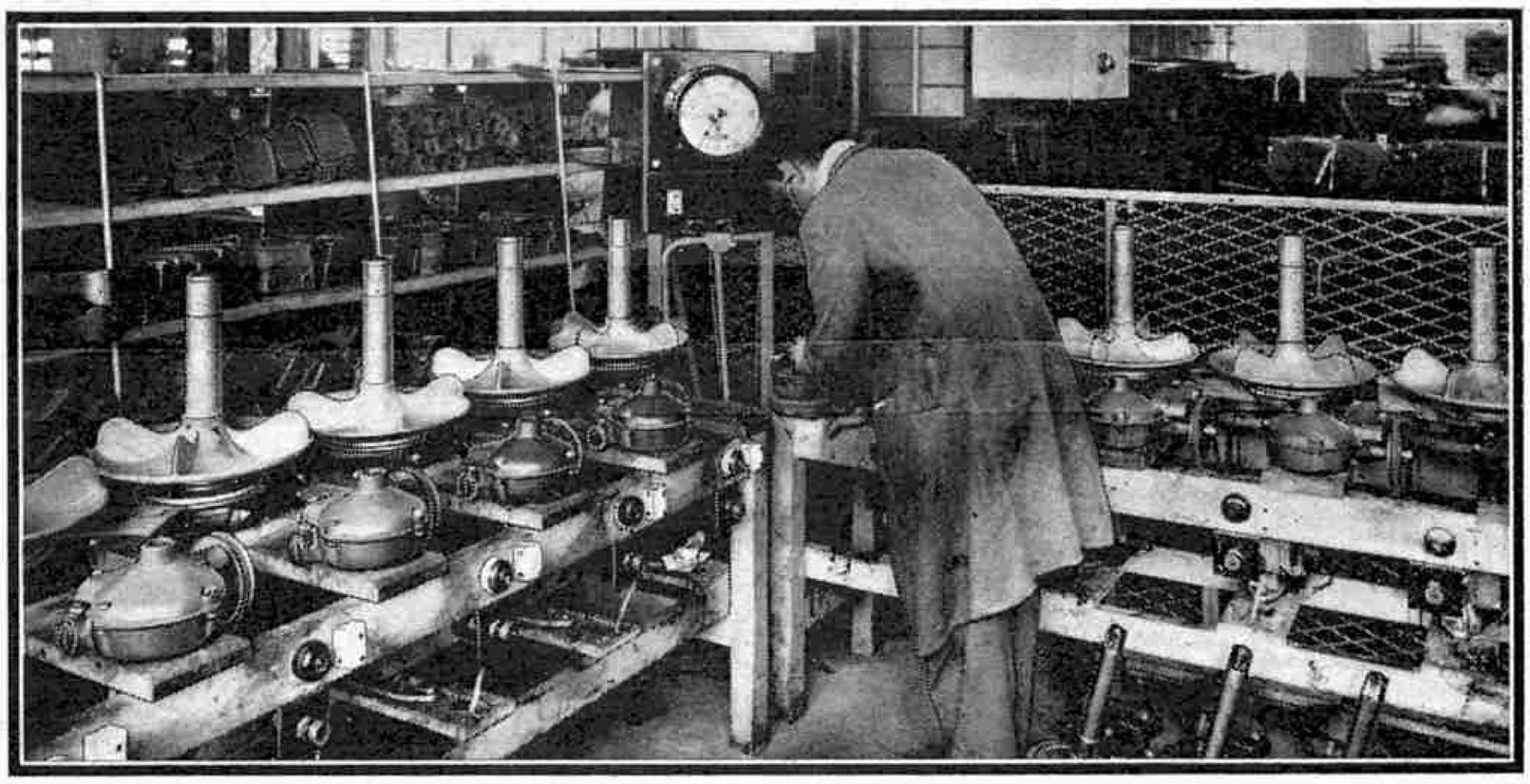
Assembling and testing the compressors of "BTH" refrigerators.

A less familiar appliance that promises to become very popular is the electrical refrigerator. This is particularly useful during warm weather, when difficulty is experienced in preserving foodstuffs and in keeping them in fresh condition until they are required. The electrical refrigerator solves this difficulty by providing a cabinet in which the temperature is kept at freezing point or a little above it. The use of ice for refrigeration has long been known, but perhaps the most startling proof of the efficiency of low temperature for preserving foodstuffs was given by the discovery in the frozen wastes of Northern Siberia of the buried carcass of a mammoth that was fit to eat, although the creature itself had been dead for at least 20,000 years. This event was the third of its kind, as explained on page 18 of "*Our Wonderful World*" in the "*M.M.*" for January of this year; and on all three occasions the flesh of the prehistoric mammoths was edible, and even tasty, but was described as rather tough!

The modern refrigerator makes us independent of ice. Its action depends on the fact that the best means of removing heat is to use it for melting a solid or evaporating a liquid. For instance, a block of ice in a room lowers the temperature because in melting it absorbs heat. Similarly the temperature of butter may be kept low by placing it in an unglazed porcelain container standing in water, for the liquid that penetrates into the pores of the vessel evaporates readily and in so doing absorbs heat, thus keeping the temperature of the vessel and its contents a little lower than that of the surroundings.

The well-known "BTH" refrigerator makes use of evaporation for the purpose of lowering the temperature in the interior of the storage cabinet. The liquid employed is sulphur dioxide, which at

ordinary pressure is a gas that can be recognised by its peculiar pungent smell, but when compressed becomes a liquid. In the course of refrigeration therefore the gas is compressed by means of a small pump driven by an electric motor, and at the same time is passed through pipes cooled by running cold water. The combined effect of the cooling and the compression is to cause liquid sulphur dioxide to accumulate in a special compartment. A float valve opens when this chamber contains a sufficient quantity of liquid, and some of this then flows into the evaporator, where the pressure is suddenly released and the liquid becomes a gas. As already pointed out, the sulphur dioxide must absorb heat from its surroundings in order to complete this change. The tubes through which it passes therefore become very cold, and in their turn abstract heat from the interior of the storage cabinet. The sulphur dioxide expands along tubes leading to the pump, and is returned to the compressor and float chamber, where it is again cooled and condensed into a liquid. Thus it circulates continually while the refrigerator is in action, abstracting heat from its surroundings as it passes through the evaporator, and delivering this up in the condenser.



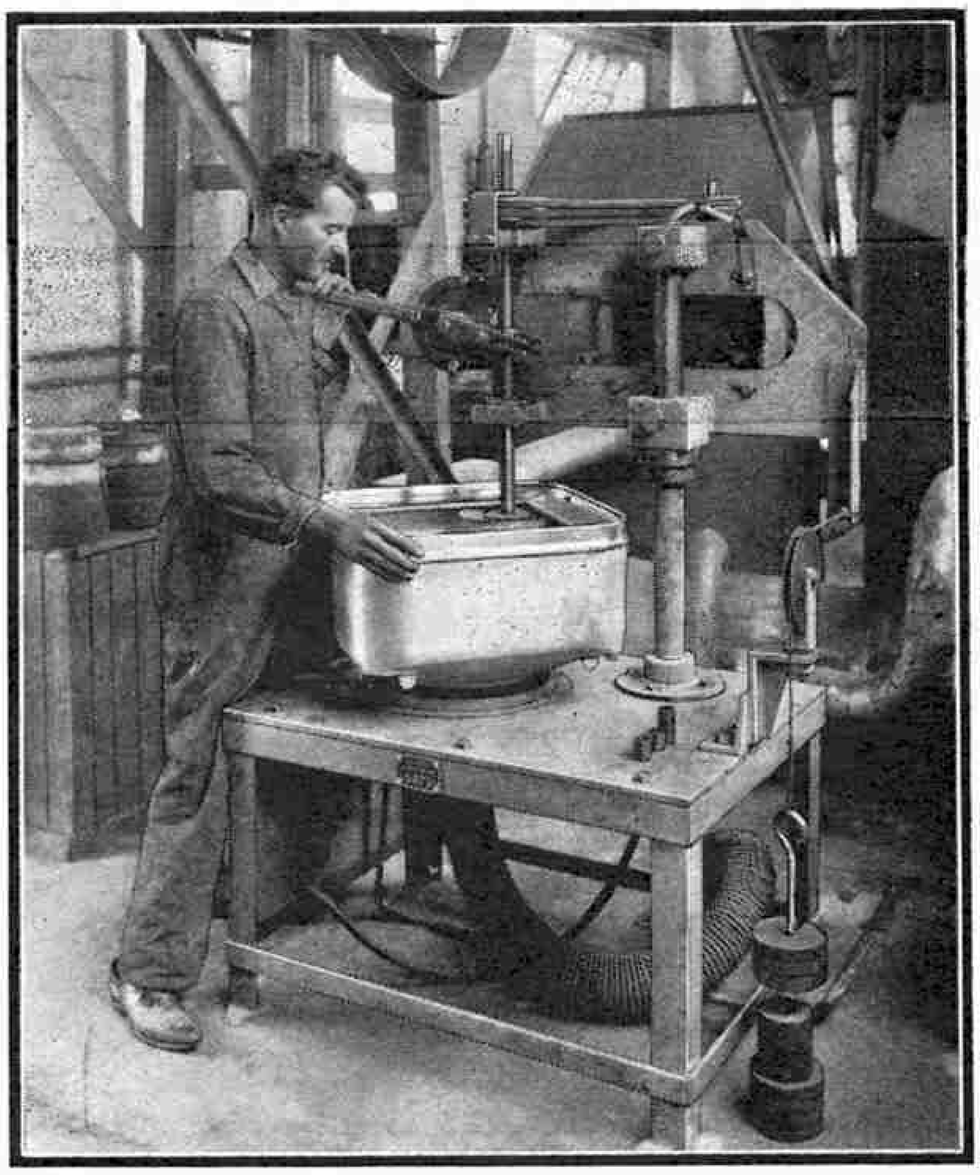
Gear-boxes under test before being fitted to washing machines. Behind each gear-box is one of the winged gyrators employed to agitate the contents of the tubs of these machines.

The working part of the "BTH" refrigerator is distinct from the cabinet and fits on top of it, the compressor unit remaining outside the cabinet when assembly is complete, while the evaporator fits into the actual space where the low temperature is required. The compressor itself, consisting of the pump and the small motor that drives it, is enclosed in a sealed steel dome on to which is pressed the condenser, which takes the form of coils of copper tubing in which the sulphur dioxide is cooled while on its way to the float chamber. The unit is then welded to the base plate, and the float chamber is fitted, after which the necessary pipe connections are made and all joints are tested for leakage. Oil is then introduced to act as a lubricant for the moving parts. A special feature of the "BTH" refrigerator is that no further oiling is required, as the working parts are sealed into the dome, and oil is fed under pressure to every bearing without special attention.

The next stage is to place the evaporator in position below the base plate, which forms the top of the cabinet, and to make the pipe connections. The refrigerator unit is now complete, and after it has been dried the air is pumped out and the necessary quantity of sulphur dioxide is introduced. Exhaustive tests then follow. These are designed to ensure silent operation and refrigerating power, and one of the ordeals to which the refrigerator is subjected is that of working in a room where the temperature is maintained at 100°F.

In the meantime the refrigerating cabinet is being built. It is made in two sections, an inner cabinet being placed within an outer casing, with heat-insulating material in the gap between them. The first stage in its production consists in cutting from sheet steel the pieces required for the walls of the two sections and their supports, and these are then bent to shape on a gigantic press that is claimed to be the largest all-British machine of its kind in the country. The joints are then welded and smoothed down.

The parts of the cabinets are now beginning to take shape, and the next step is to enamel them. The outer cabinet is given a coating of white cellulose enamel, while the inner cabinet is covered with vitreous enamel, which during its passage through a special furnace melts into a clear glassy material that cannot absorb dust, or liquid accidentally spilled on it, and therefore is particularly suitable for the interior surfaces of a container in which foodstuffs are to be stored. The heat-insulating material is then packed round the inside of the outer cabinet, and the inner cabinet is placed in position within it. The assembly is completed by fitting the door, and the cabinet is ready to have the refrigerator unit dropped into place.

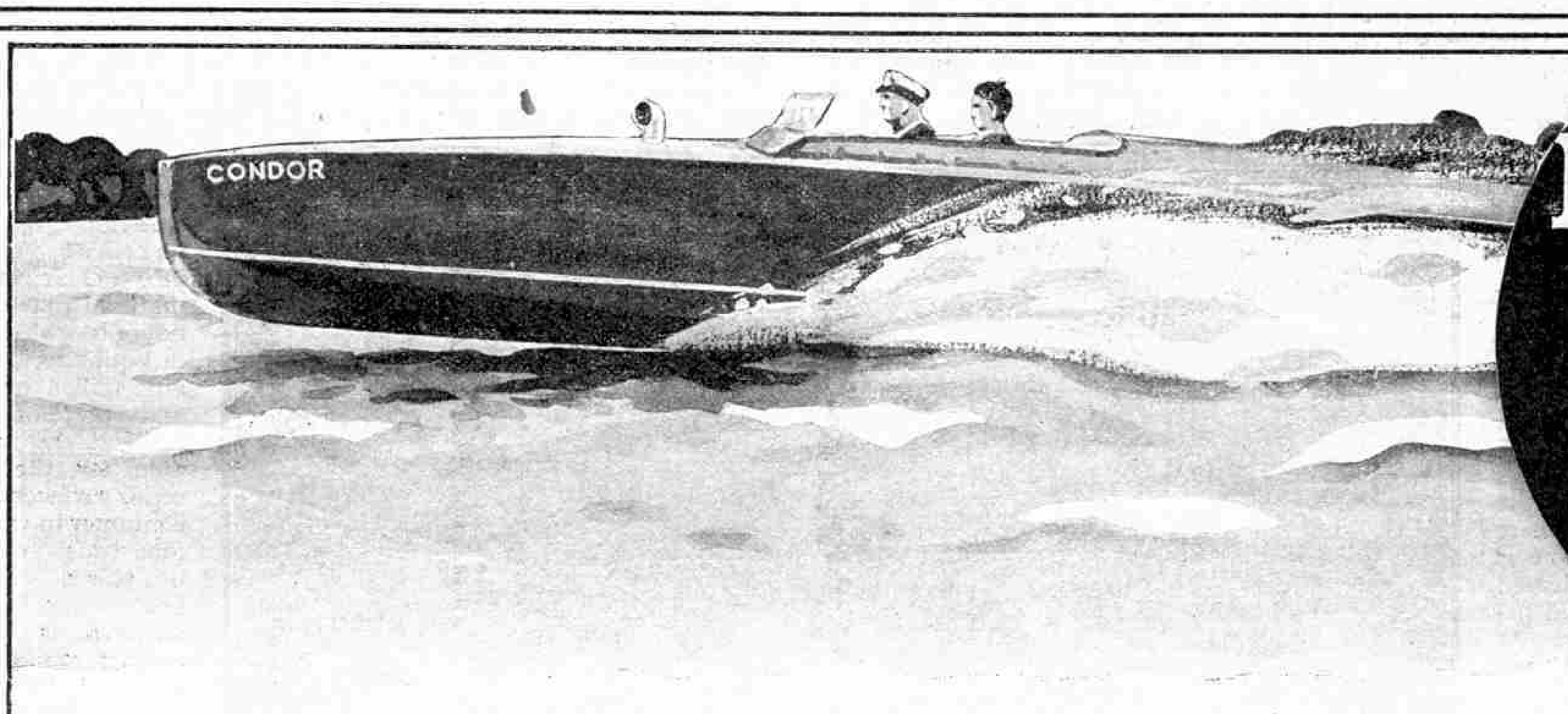


Polishing the aluminium alloy tub of a "BTH" washing machine in order to give it a smooth interior surface.

Another "BTH" production of an entirely different type has been introduced to lighten the burden of washing clothes, one of the hardest and least pleasing of all domestic duties. The coming of the electric motor has considerably altered the prospects in this sphere, for it can be made to undertake all the hard work of washing, and also of the necessary wringing and ironing. All these operations can be carried out with the aid of the "BTH" electric washer, parts of which are illustrated. The washing is done in a tub made of aluminium alloy in the bottom of which is the gyrator. This gyrator looks like a four-vaned propeller, but it does not rotate continuously, its direction being reversed at every half-revolution of the worm-driven gear wheel that operates it. As it swings round and back again, the water with which the tub is charged circulates through the clothes being washed, agitating them thoroughly and thus preventing them from bunching together and resisting the cleansing action. No idle suds collect on top of the water, for the circulation draws the soap down into the liquid in order to compel it to carry out its work; and a sediment trap at the bottom of the tub removes suspended dirt.

The washer is equipped with a wringer consisting of two rubber rollers. The lower roller is hard and is given a crepe finish to provide grip; the upper one is softer, and when in action can be seen to fold over articles passing under it, thus ensuring thorough wringing. Anything from a handkerchief to a blanket can be dealt with in the machine, and a simple switch gives the operator complete control.

Ironing also can be accomplished with the aid of the motor incorporated in the "BTH" washer, for it can be equipped with a rotary iron. This iron includes an electrically-heated shoe that is capable of doing as much work as 10 ordinary flat irons operated at once, and it presses on a rotating cylinder 26 in. in length that carries the articles to be ironed. The controls are so interlocked that normally the roller is stationary when the shoe is rocked clear of it, but begins to revolve immediately contact is established, thus preventing risk of damage to the roller covering by over-heating. The most delicate ironing operation can (*Continued on page 248*)



HORN SPE BOA

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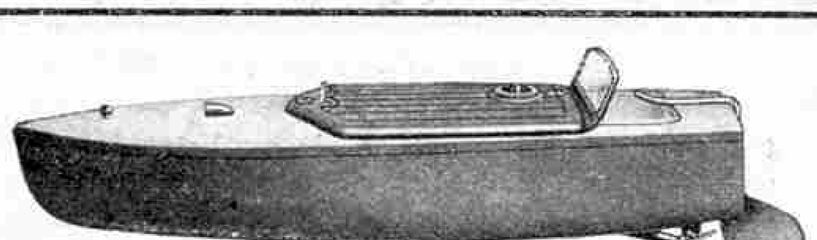
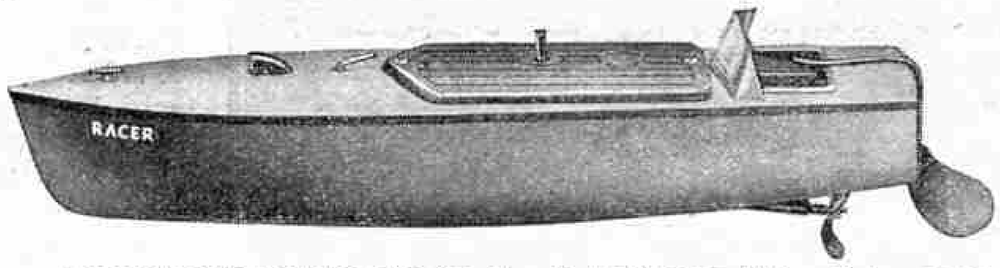
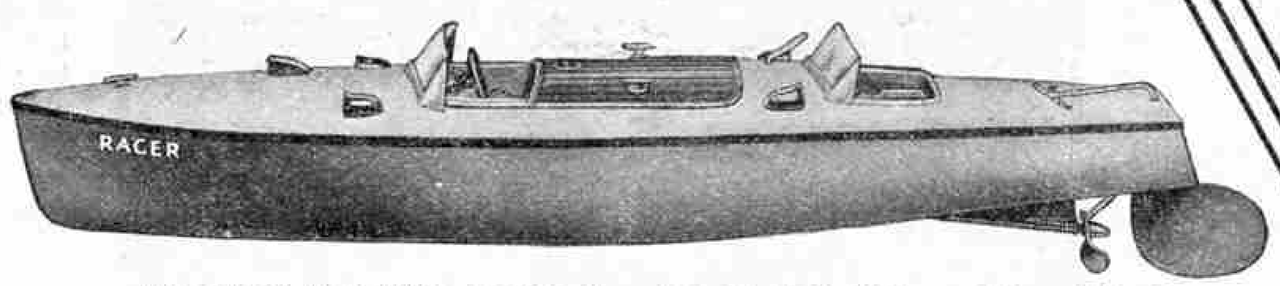
Nothing like the new 1934 Hornby Speed Boats and H in model boat construction. They are superb! E general characteristics of the wo
Ask your dealer to show you the full range, or ser



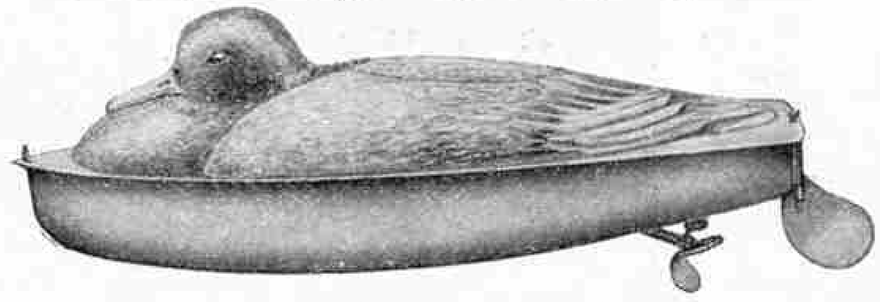
HORNBY RACING BOAT No. 1 "RACER I." Price **4/6**
Travels over 120 ft. at high speed on one winding. Finished in cream and green. Dimensions: Length 8½ in. Beam 2⅜ in.



HORNBY RACING BOAT No. 2 "RACER II." Price **8/6**
Travels over 200 ft. at high speed on one winding. Finished in Blue and Cream. Dimensions: Length 12½ in. Beam 3 in.



HORNBY RACING BOAT No. 3 "RACER III." Price **14/6**
Travels over 300 ft. at high speed on one winding. Finished in Red and Cream. Dimensions: Length 16½ in. Beam 3½ in.



HORNBY WATER TOY (DUCK). Price **3/3**
Travels over 100 ft. on one winding. Finished in appropriate colours. Dimensions: Length 9¼ n. Beam 3 in.

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When other boats are slowing up, the Ho strong. The special design of the prop employed in the construction of the hu speed and length of run. Every line an Speed Boats emphasises their excellent Each model is available in three diff

HORNBY RACING

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This novel boat is p suitable for young The deck car realistically m model of a D

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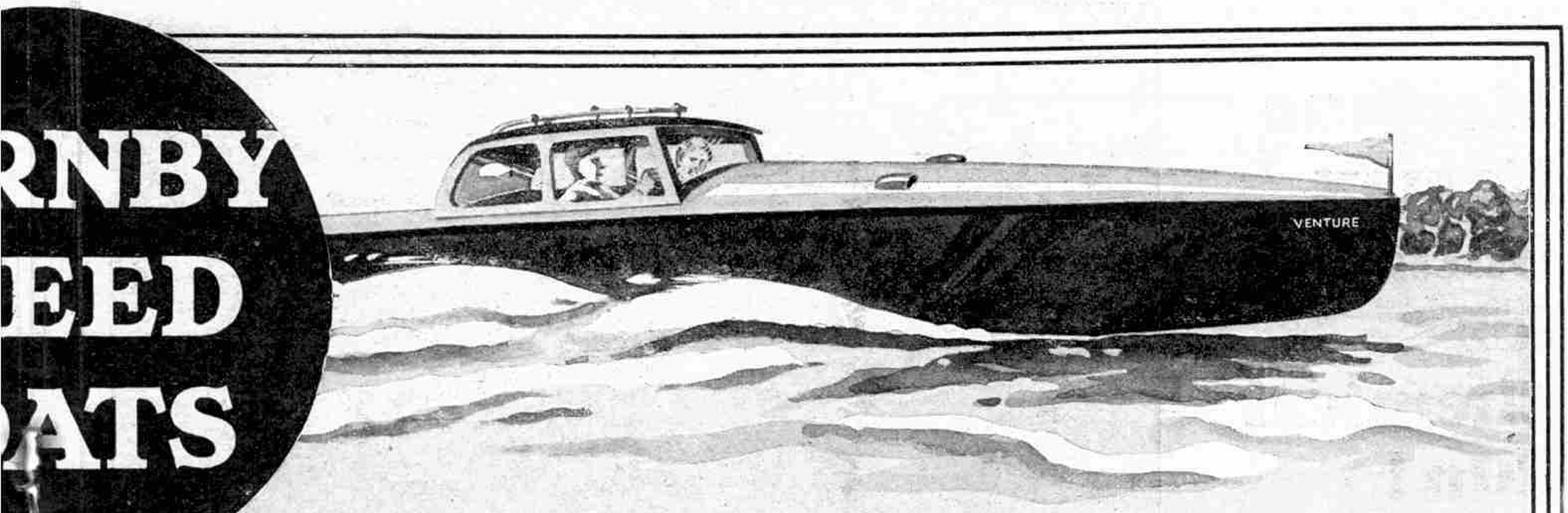
Join the Hornby Speed Boat Club

Every owner of a Hornby Speed Boat or Hornby Racing Boat should join the Hornby Speed Boat Club. This may be done by purchasing a special badge (illustrated here) from any Meccano dealer, or direct from Meccano Ltd., Binns Road, Liverpool 13. Prices: United Kingdom, **6**d., New Zealand, **10**d., South Africa **9**d., Canada, **20** cents.

HORNBY SPEED BOAT CLUB

Manufactured by Meccano Ltd.,



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Brighter Colours
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the new Water Toy are the finest examples of model rformance, graceful lines and beautiful finish are the ats. They introduce a new standard of excellence in be proud to possess one of them.
ats and Hornby Racing Boats has been known before perb ! Each model follows closely the design and f the world's famous speed boats.
ge, or send to us for a copy of the new price list.

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, the Hornby Speed Boats are still going the propeller and the unique methods of the hull give each model exceptional y line and every feature of the Hornby xcellent qualities, speed and reliability. hree different colour combinations.

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Boats have been introduced to nand for faster boats to be used pecially constructed to travel r remarkable perform- beautiful appearance or them a unique ongst boys.

WATER TOY

boat is particularly r young children. ck carries a ally moulded of a Duck.

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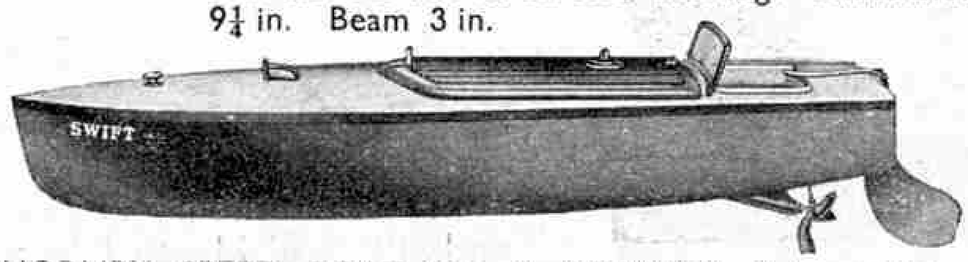
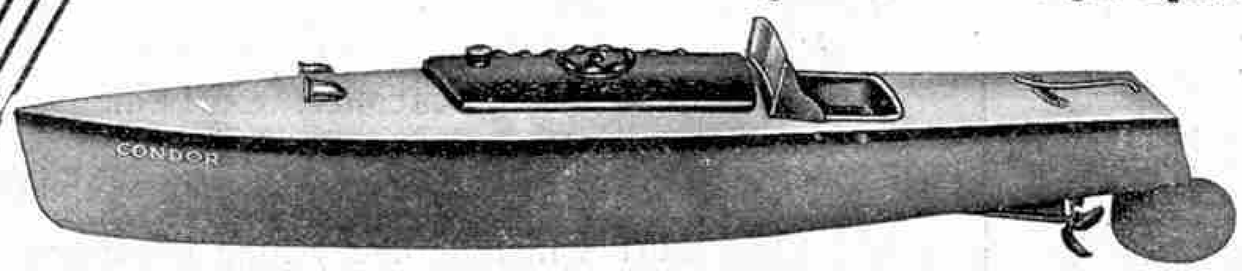
HORNBY SPEED BOAT No. 1 "HAWK." Price **2/11**
Travels over 100 ft. on one winding. Dimensions : Length 9¼ in. Beam 3 in.



HORNBY SPEED BOAT No. 2 "SWIFT." Price **7/6**
Travels over 300 ft. on one winding. Dimensions : Length 12½ in. Beam 3 in.



HORNBY SPEED BOAT No. 3 "CONDOR." Price **12/6**
Travels over 500 ft. on one winding. Dimensions : Length 16½ in. Beam 3½ in.

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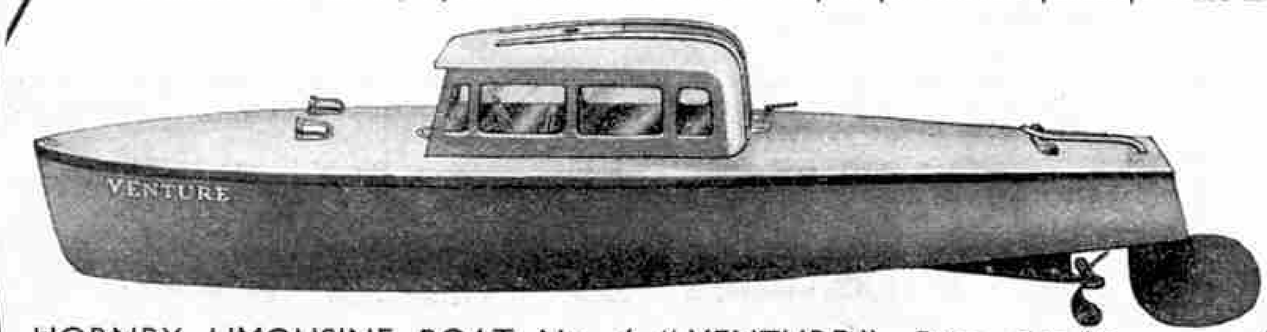
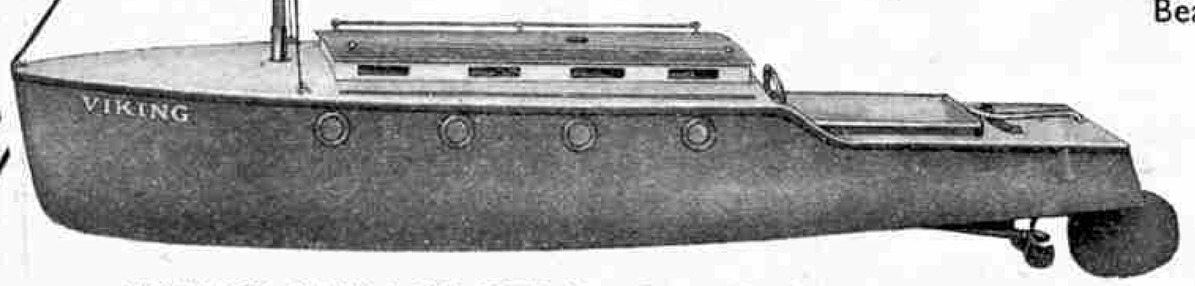


HORNBY LIMOUSINE BOAT No. 4 "VENTURE." Price **15/6**
Travels over 500 ft. on one winding. Dimensions : Length 16½ in. Beam 3½ in.



HORNBY CABIN CRUISER No. 5 "VIKING." Price **16/6**
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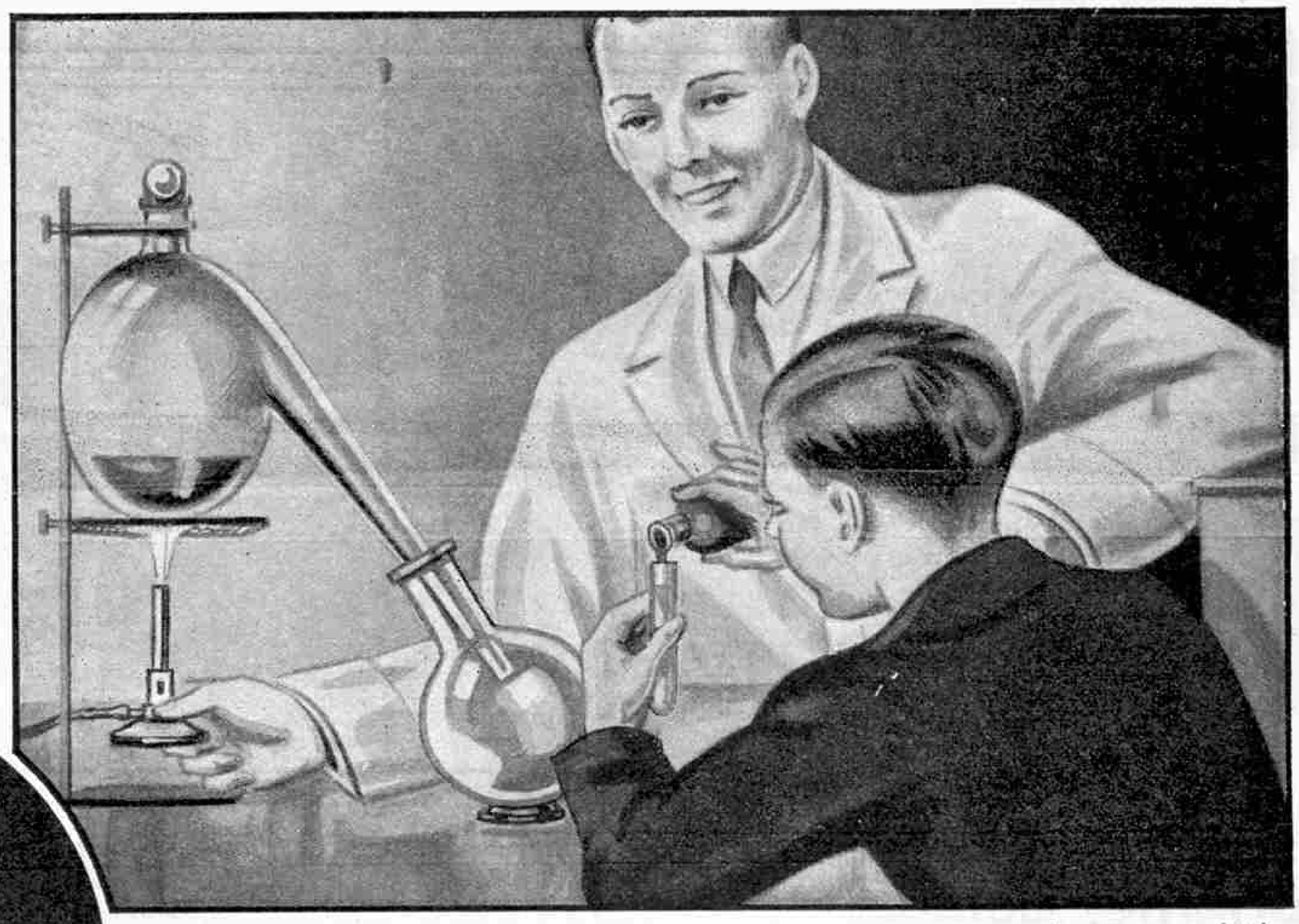
Meccano Kemex Outfits for Chemical Fun!



Nº2 KEMEX CHEMICAL OUTFIT

No. 1 KEMEX OUTFIT

130 Experiments

This Outfit contains a supply of specially selected chemicals, packed in airtight containers, together with a length of Magnesium Ribbon, sufficient to perform 130 attractive and varied experiments. The apparatus provided in the Outfit includes Test Tubes and a Test Tube Holder, a Funnel, Filter Papers, and Glass Delivery Tubes, with a simple and highly-efficient Spirit Lamp that makes the Outfit completely self-contained.
Price **7/6**

No. 2 KEMEX OUTFIT

250 Experiments

This Outfit includes the whole of the contents of the No. 1 Outfit, and further chemicals that increase the range of experiments up to 250. The additional apparatus includes a porcelain Evaporating Dish, Special Test Tubes to withstand high temperatures, a handsome Test Tube Stand, and an Evaporating Stand including a Ring, with Wire Gauze.
Price **15/-**

No. 3 KEMEX OUTFIT

350-400 Experiments

This is a splendid complete Outfit that provides a boy with all he requires to carry out between 350 and 400 experiments, and thus enables him to acquire a sound knowledge of the fascinating principles of chemistry. The Outfit includes the contents of the No. 2 Outfit, with additional chemicals and apparatus. The latter includes a gas-generating apparatus, consisting of a large Wide-necked Flask with Thistle Funnel and Delivery Tubes, and a Blowpipe and a Charcoal Block. These items open up a series of experiments of outstanding interest. There is also an extension for use on the Evaporating Stand, to which apparatus may be readily fitted on similar lines to those adopted by actual chemists.
Price **25/-**

Get an Outfit Now
and carry out hundreds of interesting experiments

The contents of the Meccano Kemex Chemical Outfits provide many hours of fascinating fun. With the apparatus and materials contained in them a boy can make inks and soaps ; dye wool, cotton and silk, and bleach fabrics that are already dyed ; test foodstuffs for impurities ; analyse air and water ; grow crystals ; write with electricity ; smelt metals from their compounds ; make invisible inks and a chemical garden ; prepare gases, and perform a host of other interesting chemical experiments.

Everything made quite simple

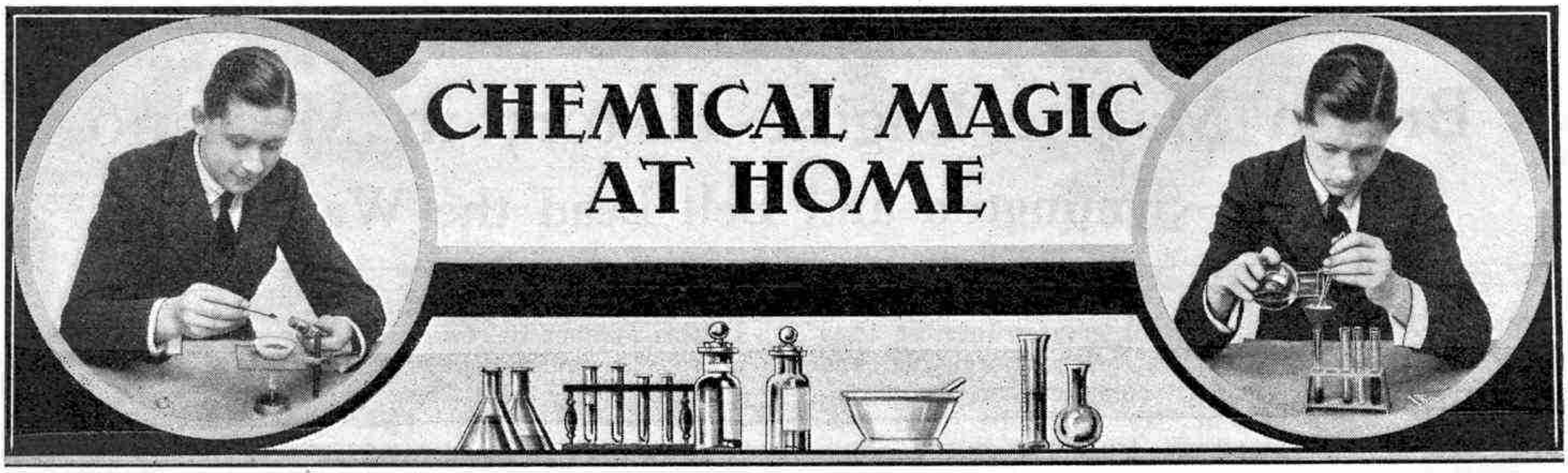
The Outfits include everything necessary, and the hundreds of experiments that may be made are described in a simple manner in an attractive Manual that is included in each Outfit. The Manuals are illustrated with a series of actual photographs showing how the apparatus required is fitted up, and the manner in which each experiment is carried out.

The apparatus included in Kemex Outfits and refills of Kemex Chemicals can be obtained separately. Ask your dealer for the leaflet giving a list of Kemex parts and their prices, or write for a copy to the address given below.

MECCANO KEMEX
CHEMICAL OUTFITS

Manufactured by

MECCANO LIMITED
BINNS ROAD, LIVERPOOL 13



DETECTING INVISIBLE FINGER-PRINTS

ONE of the favourite amusements of amateur chemists is that of making a variety of inks and applying them to special purposes. Owners of Kemex Outfits will have no difficulty in carrying out many interesting experiments of this kind with the material at their disposal, and in making good use of the inks they produce.

Originally inks were made from galls and green vitriol. Galls are vegetable growths formed on the leaves or bark of trees round the eggs deposited by certain insects. They are dark in colour and round in shape, those formed on oak trees being familiarly known as oak-apples. These galls contain tannic acid, and an extract of this, mixed with a solution of green vitriol, the chemical name of which is iron sulphate, gives a black precipitate of iron tannate. This precipitate is in a finely divided form, and the black liquid produced can be used for writing purposes.

In order to prepare a simple but good black ink one measure of Tannic Acid is dissolved in one-third of a test tube full of water, and to this solution is added a second made by dissolving a measure of Iron Alum in a similar quantity of water. The black liquid obtained is thoroughly shaken, and if a trial with a clean steel pen shows it to be a little too deep in colour, it is diluted as necessary by adding more water. The addition of a few drops of gum is advisable, for its presence will prevent the liquid from spreading or running too quickly; and the ink is best stored in a tightly-corked bottle.

A blue ink can be made in a similar manner by substituting Sodium Ferrocyanide for Tannic Acid, and the two inks can be combined into a really good blue-black ink by mixing equal quantities of the liquids. Writing for which this ink is used is blue, but turns black after a few days.

How to Make Coloured Inks

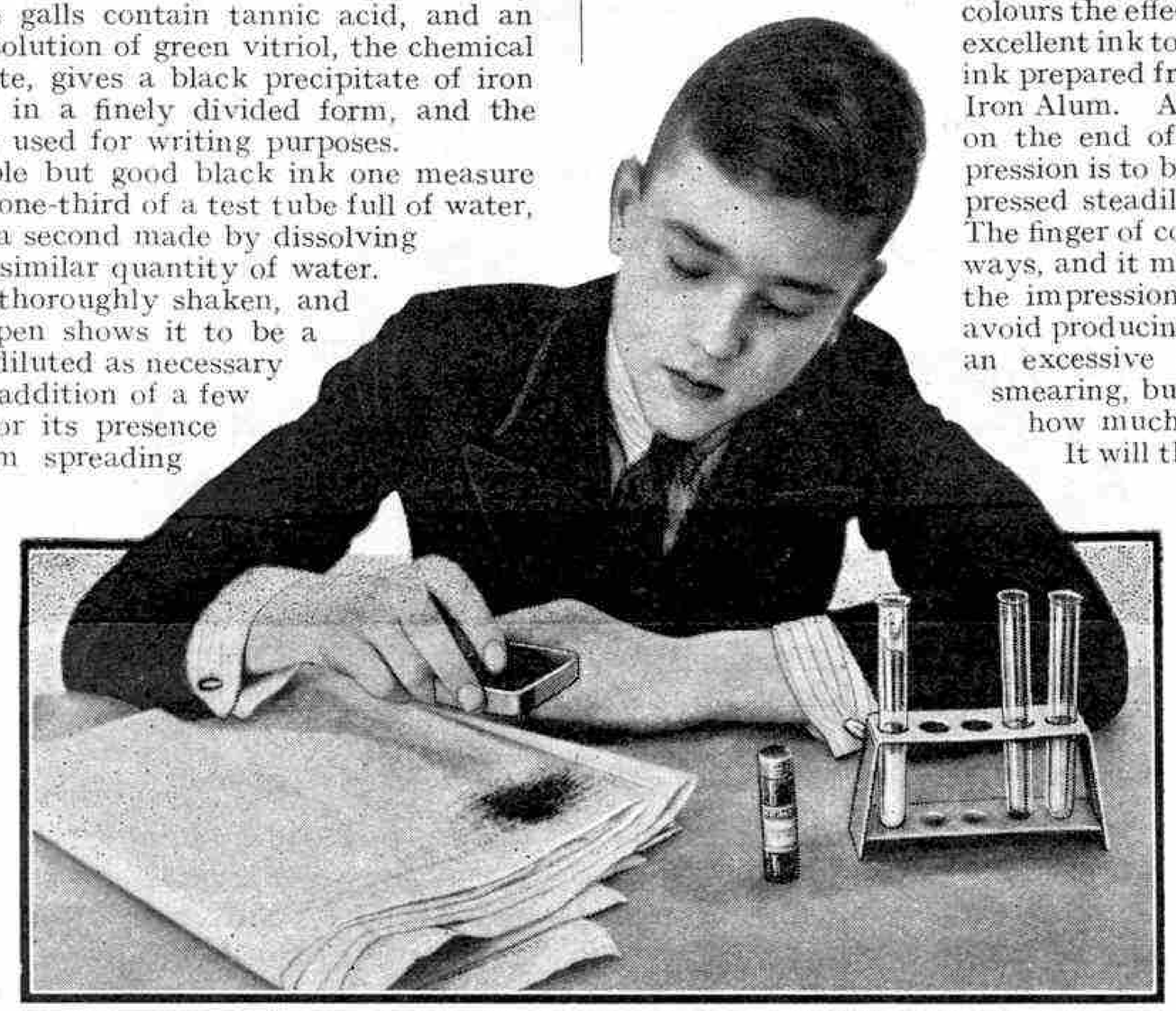
Coloured inks are always a source of great interest. A good purple ink can be made from Logwood. Three measures of this are boiled with a little less than half a test tube full of water until a deep red solution is obtained. Then one measure of Aluminium Sulphate is dissolved in the red liquid and this is again boiled, giving a liquid with a splendid deep purple colour. A Logwood solution prepared in the same manner as in this experiment is converted into an excellent red ink by adding to it one measure each of Sodium Bisulphate and Aluminium Sulphate, and boiling.

All these inks have the disadvantage that writing carried out with them can be erased either by means of an indiarubber or by scratching with the blade of a penknife. A more durable ink is obtained by dissolving one measure each of Tannic Acid and Iron Alum in about one-third of a test tube full of water, and pouring the mixture into a cup or saucer in which is about half a teaspoonful of water-glass. After these are mixed together, a measure of powdered Charcoal is added and thoroughly stirred in. The best results are obtained when the Charcoal is crushed as thoroughly as possible by grinding it in a mortar or other suitable vessel.

When this ink is used for writing, the Charcoal particles are carried into the pores of the paper and cannot easily be removed by rubbing. In addition they cannot be bleached, for agents that bring about changes of this kind have no action on carbon, the chemical element constituting the Charcoal. For these reasons printer's ink is made from lampblack, or finely divided carbon obtained by burning coal gas in a limited supply of air.

Inks for Finger-Print Impressions

One interesting use to which inks can be put is that of obtaining finger-prints, and if these are taken in various colours the effect is startlingly attractive. An excellent ink to use for the purpose is the blue ink prepared from Sodium Ferrocyanide and Iron Alum. A little of this is painted evenly on the end of the finger of which an impression is to be taken, and the finger is then pressed steadily on a sheet of white paper. The finger of course must not be moved sideways, and it must be lifted straight up when the impression has been made in order to avoid producing an indefinite smudge. Using an excessive amount of ink also causes smearing, but a little experience will show how much is required for good results. It will then be found great fun to take the finger-prints of as many friends as possible, and to compare the curves of these curious markings.



The Kemex detective at work. Making finger-prints on a newspaper visible by sprinkling coloured powder over them.

Every reader knows how valuable finger-prints are to the police and in detective work. An impression is almost always left when the end of the fingers are pressed on a smooth surface, particularly if the hands are slightly moist or a little greasy; and as no two persons make exactly similar imprints, the marks can be used for identification purposes. The various types of curves produced have been carefully classified, and a register of the fingerprints of known criminals is now one of the chief weapons of practically every police force in the world.

Finger-prints of this kind are usually not readily visible, but fortunately it is not difficult to reveal their presence, all that is required for the purpose being a coloured powder that will adhere firmly to the lines of the impressions. A suitable powder can readily be made by mixing equal quantities of Sulphur and powdered Charcoal. In order to show that this mixture is effective, the end of the finger is slightly moistened by breathing on it, and is then pressed firmly on a sheet of paper, on which it leaves an invisible impression. A little of the mixture is then shaken over the paper, preferably from a small muslin bag or a cardboard or metal box with small holes pierced in its base. The under side of the paper is then very gently tapped in order to bring the fine particles of powder into close contact with the impression, and this immediately becomes visible on shaking the surplus material off.

A similar plan is followed in investigating objects on which the presence of finger-prints is suspected, and any impressions discovered are photographed and compared with those preserved in the records.

British Marine Engine History in Meccano

I.—Symington and Bell Lead the Way

THERE are few subjects of greater interest than marine engineering, for without reliable and efficient ships' engines, commerce on the world-wide scale of the present day would be impossible. Great Britain is particularly dependent on steamship services, for the greater part of her foodstuffs and raw materials for her industries are imported and in return she exports coal and manufactured goods to all parts of the world. It is scarcely surprising, therefore, to find that British engineers have played a great part in the development of the modern steam vessel.

The story of the growth of the marine engine from that installed in a small boat in 1786 by William Symington, the pioneer of marine engines in this country, to the great quadruple expansion engines and steam turbines of the present day, is one of the romances of engineering. In this series of articles this growth will be followed with the aid of Meccano models, each of which illustrates an important advance in marine engineering. The models will not only show the first engine ever employed in a British ship, but also will demonstrate how successive changes have led to the development of the powerful modern engines that drive immense vessels at high speed and yet are economical in regard to fuel consumption.

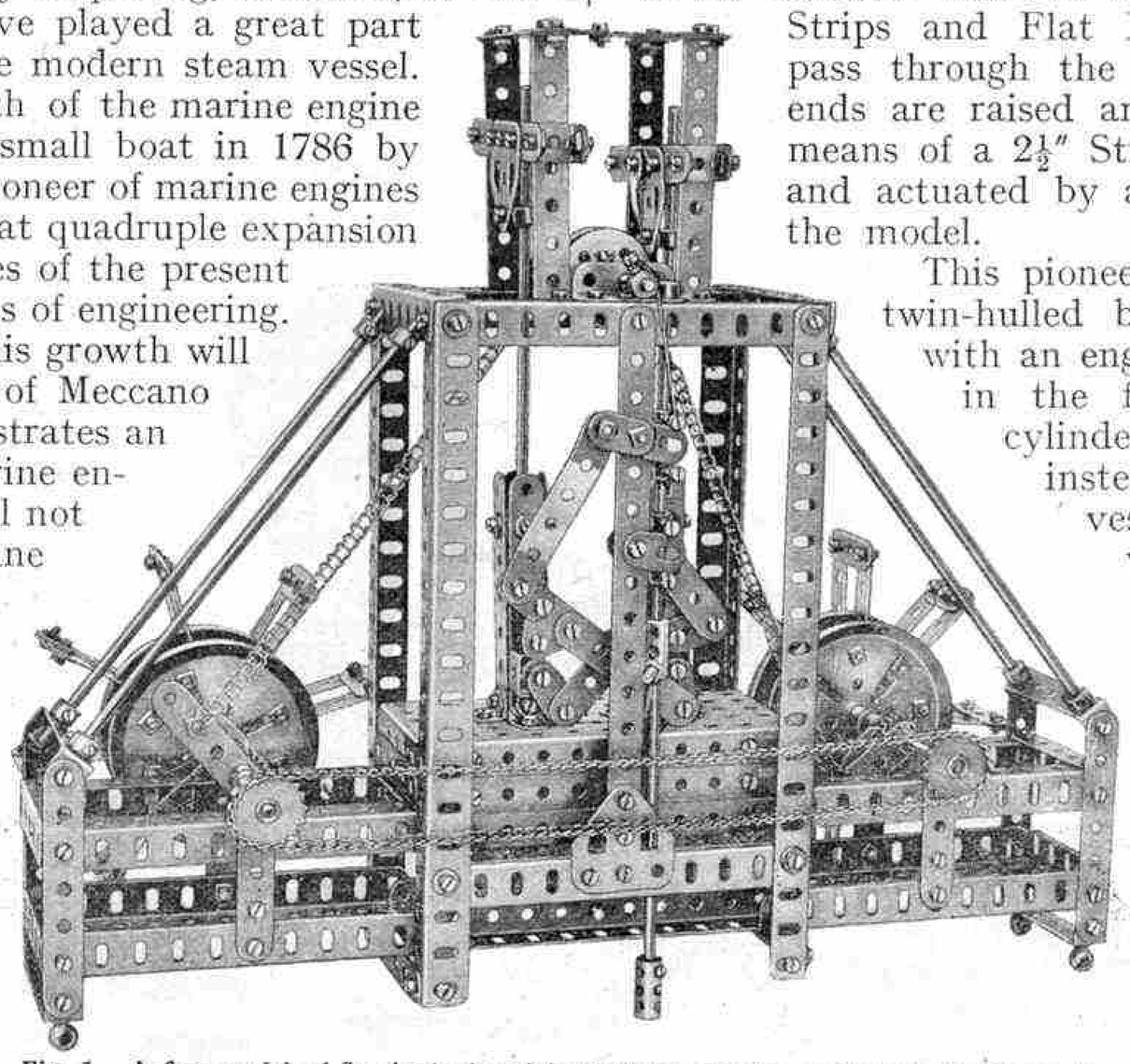


Fig. 1. A fine model of Symington's original Marine Engine, built with Outfit No. 6.

As already indicated, the first successful application of steam to a British vessel was due to William Symington, who in 1786 took out a patent for this method of propulsion. Symington was a mining engineer who fitted an engine to a boat owned by Patrick Miller, a retired Edinburgh banker, and in 1788 the vessel was tried with success on a lake owned by Miller at Dalswinton, near Dumfries.

Although the details of Miller's boat have been lost, Symington's engine is preserved in the South Kensington Museum, London, and forms the subject of the model shown in Fig. 1. Each of the two cylinders is built up from four $3\frac{1}{2}''$ Strips and they are mounted $2\frac{1}{2}''$ apart on top of the condenser that is constructed from two $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates coupled together, in the form of a shallow box, by means of four Flat Brackets.

The piston rods are attached at their outer ends to crossheads working in slides fitted outside the main framework of the engine. One end of a length of cord is secured to each piston rod, and the cords pass in opposite directions round two large Flanged Wheels situated between the two piston rods. The cords are then attached to lengths of Sprocket Chain, one end of each being coupled to a pawl and ratchet mechanism. In this manner the two pistons, working alternatively, operate the paddle wheels, the rotation of which is made continuous by connecting them together by means of Sprocket Chain.

The valves are operated from a vertical tappet rod, the lower end of which is weighted and the four tappets consist of $\frac{3}{8}''$ Bolts carried in Collars. It should be noted that the inlet valve of one cylinder is coupled to the exhaust valve of the opposite cylinder by $2\frac{1}{2}''$ Strips and Flat Brackets. The piston rods pass through the condenser and their lower ends are raised and lowered alternatively by means of a $2\frac{1}{2}''$ Strip pivoted about its centre and actuated by a Crank on the far side of the model.

This pioneer vessel was followed by a twin-hulled boat 60 ft. in length fitted with an engine similar to that installed in the first boat except that its cylinders were 18″ in diameter instead of 4″ as in the earlier vessel. A speed of 7 m.p.h. was attained in trials on the Forth and Clyde Canal but in spite of this success Miller for some reason or other became dissatisfied and abandoned the experiments. Symington persevered, however, but although he continually attempted to interest influential people in his designs he made no progress until ten years later, when Lord Dundas commissioned him to build a steam boat suitable for towing barges along the Forth and Clyde Canal. The commission was accepted and the result was the first successful steam tug in the world.

The "*Charlotte Dundas*," as this boat was named, was commenced in 1801 and her first trip was made early in 1802. After a few preliminary experiments a practical trial was made in March of that year when two well-laden barges, each of 70 tons burden, were towed against a strong head wind at a speed of over 3 m.p.h. for a distance of nearly 20 miles. Strong complaints were made by the directors of the canal in regard to damage done to the banks by the wash from the vessel, and Lord Dundas was compelled to abandon the enterprise. The "*Charlotte Dundas*" was withdrawn and placed in a lock at the side of the canal, where she remained until she fell to pieces.

This interesting vessel was 56 ft. in length with a beam of 18 ft. She was fitted with a stern paddle wheel driven by a direct-acting horizontal engine, the first of this type ever built, the cylinder of which had a diameter of 22 in. and a stroke of 4 ft. The boiler, the design of which played a great part in the success

of the vessel, had an internal furnace, a practice that was not generally followed until many years after the death of Symington.

The appearance of the engine of the "*Charlotte Dundas*" is well represented in the model illustrated in Fig. 2. As will be seen from this, the engines in many modern factories are of the same type. The crosshead of the original engine consisted of two rollers, each working on a separate rail; and each side of the crosshead frame carried two levers connected by vertical levers to air pumps that were used for emptying the condenser of water and air. The piston rod was coupled by a long connecting rod to a crank mounted directly on to the paddle shaft. These and other features are reproduced in the model, except that the paddle wheel is shown fitted with four floats in order to keep the model within a No. 4 Outfit, although actually eight floats were used.

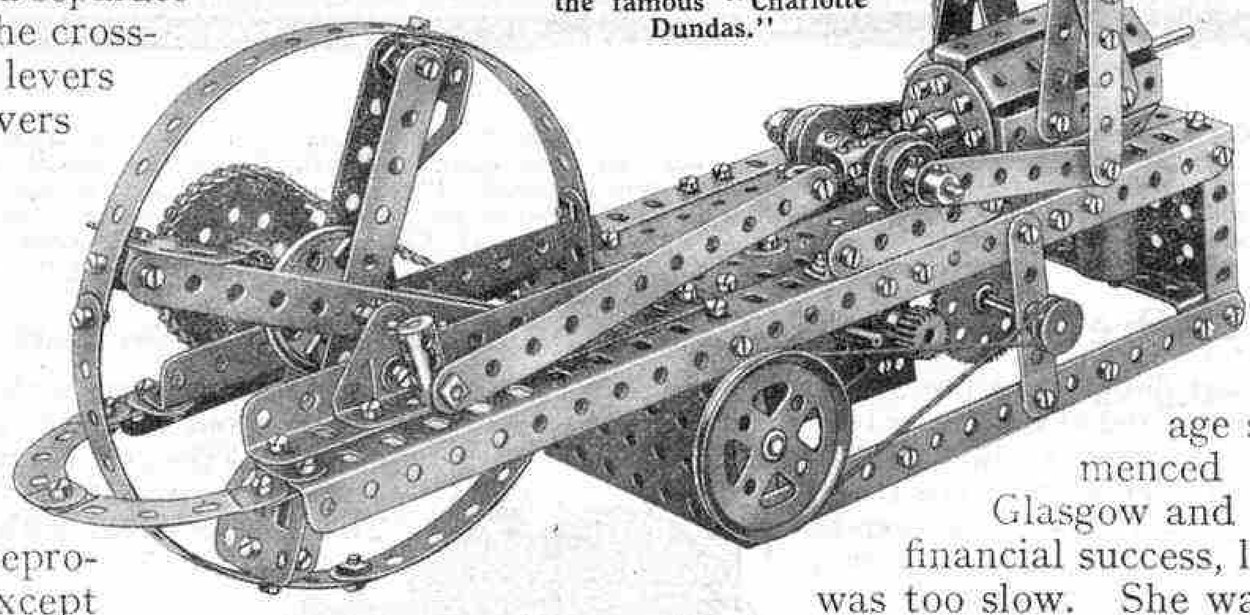


Fig. 2. The first direct acting steam engine ever built, faithfully reproduced in Meccano. These engines were fitted into the famous "Charlotte Dundas."

In the model the deck is represented by two $12\frac{1}{2}$" Angle Girders joined together at one end by $3\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plates. The frame so formed is raised on two $3\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plates, these being braced together by $5\frac{1}{2}"$ and $2\frac{1}{2}"$ Strips, as shown in the illustration. The paddle wheel bearings are represented by two Trunnions bolted to $5\frac{1}{2}"$ Angle Girders that in turn are secured by Flat Brackets to the sides of the fork formed by the deck girders.

The cylinder is built up from two Bush Wheels and eight $2\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strips and is bolted to the deck by two $\frac{3}{8}"$ Bolts, on each of which two Washers are placed between the deck and the cylinder for spacing purposes. The piston rod is fitted with a Coupling that carries two small Flanged Wheels, forming the crosshead, and these roll on two $2\frac{1}{2}"$ Strips attached to the deck by $\frac{1}{2}" \times \frac{1}{2}"$ Angle Brackets. The ends of the rod carrying the Flanged Wheels are fitted with 3" Strips, and these Strips are attached by Cranks to a horizontal Rod mounted above the cylinder. A Coupling on this Rod carries a second short Rod fitted with a Swivel Bearing that is attached to the vertical valve rod. The lower end of the valve rod is journalled in a Chimney Adaptor, mounted in a Sleeve Piece fitted beneath the deck plate.

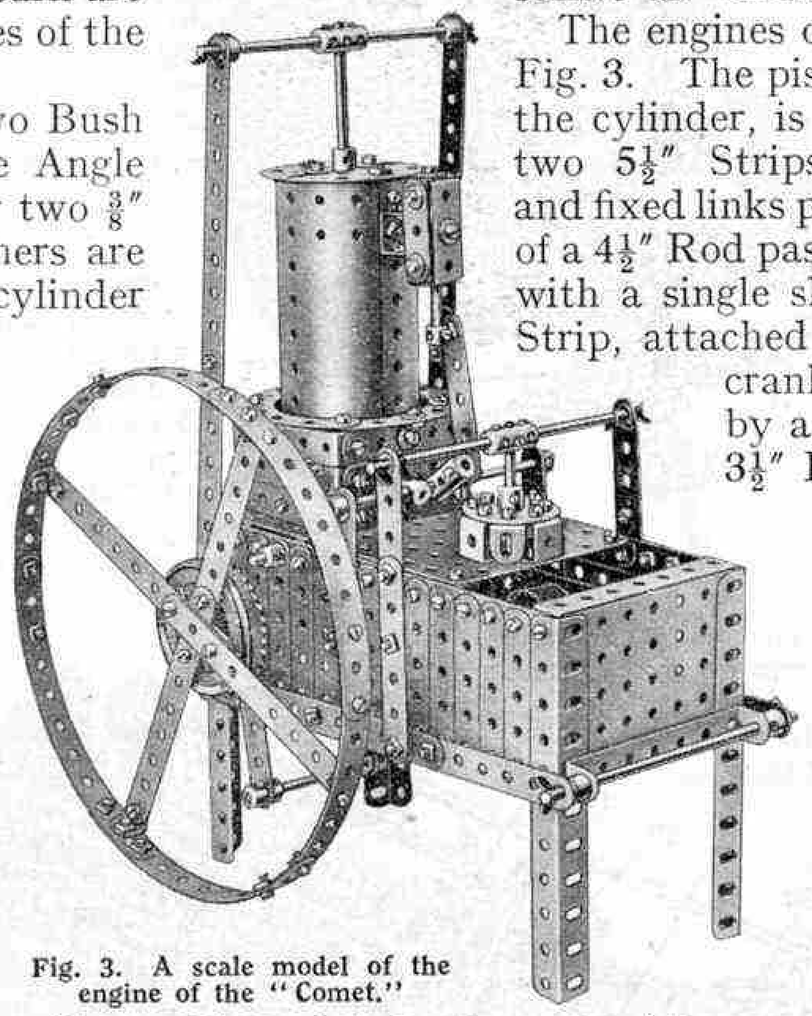


Fig. 3. A scale model of the engine of the "Comet."

The outer end of the Coupling, forming the crosshead support, carries a Threaded Pin fitted with a "spider" formed of part of a Swivel Bearing. This "spider" carries the connecting rod, the free end of which is attached by means of a Pivot Bolt to a Coupling, forming the crank.

The model is driven by means of an E1 Electric Motor, the drive from which is transmitted through a suitable gear train, a cord belt, and finally a belt of Sprocket Chain to a 2" Sprocket Wheel on the paddle shaft.

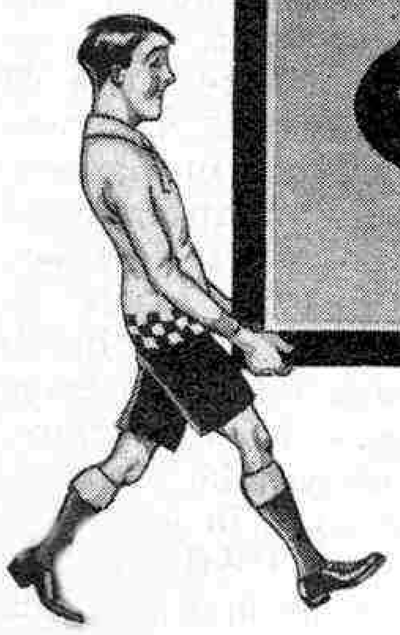
The "*Charlotte Dundas*" was Symington's last attempt at steam navigation, for the expense of building the vessel and carrying out her trials reduced him to abject poverty. He died a few years later.

The next experiment of importance were made 22 years later by Henry Bell of Helensburgh. Bell was originally a carpenter in Glasgow, but after opening a boarding house in Helensburgh, a seaside resort on the Firth of Clyde, he conceived the idea of building a steam boat to bring passengers from Glasgow. The result was the "*Comet*," a vessel 40 ft. in length on the keel, and $10\frac{1}{2}$ ft. in beam. She made her first trip from Glasgow to Greenock in January, 1812, at an average speed of 5 m.p.h. Bell commenced a regular service between Glasgow and Greenock, but this was not a financial success, largely because the "*Comet*" was too slow. She was the first commercial steam vessel to be introduced, not only in Great Britain, but also in Europe, and her appearance began a new era in ship propulsion.

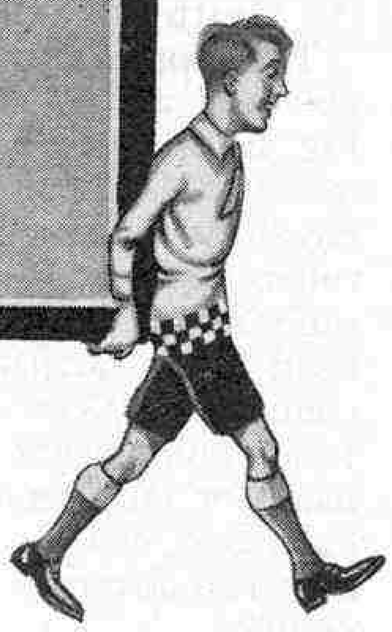
Naturally the sailing boat owners on the Clyde were greatly disturbed by the success of the "*Comet*." One skipper who greatly disliked the new vessel is said to have greeted her approach by ordering his crew, which consisted of one man and a boy, to "Kneel down and thank God that ye sail wi' A'michty's ain win', an' no' wi' the deevil's sulfire an' brimstane, like that spluttery thing there!"

The engines of this vessel are shown in model form in Fig. 3. The piston rod, which protrudes from the top of the cylinder, is coupled to two side levers by means of two $5\frac{1}{2}"$ Strips joined to represent connecting rods, and fixed links passing below these are connected by means of a $4\frac{1}{2}"$ Rod passing under the model. This Rod is fitted with a single short connecting rod, consisting of a $3\frac{1}{2}"$ Strip, attached at its upper end to a crankshaft. The crank consists of two Couplings joined together by a 1" Rod and is fitted at each side with a $3\frac{1}{2}"$ Rod. The outer ends of these two Rods are journalled in the sides of the model. A $2\frac{1}{2}$: 1 Sprocket Chain drive and a 9 : 1 gear train connect this crankshaft with an E1 Electric Motor concealed within the box-like portion of the model representing the condenser. The steam valve is operated through a series of levers and cranks from a cam on the cran shaft. The air pump, mounted on the condenser, is actuated by two short connecting rods attached to the side levers at a point $3\frac{1}{2}"$ from their pivots. The upper ends of these connecting rods are secured together by two Rods joined in the centre by a Coupling and a short rod carried in the centre hole of this Coupling represents the pump rod. The flywheel is fitted to one side of the crankshaft and forms one of the most conspicuous features of the engine. The rim, which consists of six $5\frac{1}{2}"$ Strips each overlapping its neighbour three holes, is secured to the boss, a 2" Pulley Wheel, by means of four $4\frac{1}{2}"$ Strips.

When the actual boat was first built it was fitted with four paddles and a large spur gear, of almost the same diameter as the flywheel, also was fitted. This engine developed about 3 h.p., and no doubt would have done better if the boiler had been more efficient.



Suggestions Section "Spanner" Edited by



The ideas printed in the "Suggestions Section" should prove a real help to thousands of Meccano enthusiasts. Often we receive letters from readers who describe how they have solved some knotty problem or evolved an interesting model after studying some of the ideas that have appeared. We shall always be pleased to receive further contributions for the "Suggestions Section." Cash payments are made for all Suggestions published (excluding those mentioned in the "Miscellaneous" Suggestions column). Contributions should be accompanied by clear photographs or drawings and should be addressed to "Spanner," c/o The "Meccano Magazine."

(304)—Pre-Selector Self-Changing Gear-Box (S. Jones, Cardiff)

The present-day trend of motor car design is in the direction of reducing to the minimum the effort required of the driver to control the vehicle. The cars of the past required a great deal of skill and a considerable amount of physical effort to drive them, but the latest cars have been simplified to such an extent as to make it possible to master the art of driving them in a very short time. One of the most interesting recent developments in the direction of simplification is the self-changing type of gear-box. With such a gear-box the driver selects, by operating a small lever, the gear into which he wishes to change, and this gear is automatically brought into engagement when a pedal is depressed. By this means the gear can be selected before it is required to make the actual change. For instance, when the car is being driven along the level on top gear, the selector lever may be placed in the position for third gear. Then, when it becomes necessary to change down, the driver has only to depress the gear-changing pedal, and third gear instantly and automatically comes into operation.

An ingenious Meccano model of a self-changing gear-box is illustrated on this page. The gear-box proper is housed in a framework built up by bolting four $4\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips between two 4" diameter Circular Plates. A third Circular Plate is attached to one of the others, but spaced from it by means of two Collars and two Washers on each 1" Screwed Rod that holds it in position. The driving shaft 1 is a $3\frac{1}{2}''$ Axle Rod, and is free to rotate in the boss of the Gear 14 (Fig. 304a) and the Bush Wheels 12 and 13. It carries a Collar and another loose Bush Wheel, and is fitted with the $\frac{1}{2}''$ Pinion 4. The boss of the Bush Wheel 13 is passed through the centre hole of the Circular Plate and fitted with a Socket Coupling that carries the 57-teeth Gear 14. The Wheel 12 is fitted with nuts and bolts that engage the holes in the Bush Wheel 13, but do not protrude sufficiently to foul the Circular Plate. A $\frac{3}{8}''$ Bolt 15 is secured in one of the holes of the Wheel 12, and a length of Spring Cord 17, attached to it, is wound round the loose Collar and the boss of the third Bush Wheel to which it is secured. This third Bush Wheel carries the Threaded Pin 16 and is connected to a $1\frac{1}{2}''$ Contrate 18 in the following manner. Three of the holes in the Bush Wheel carry $\frac{3}{8}''$ Bolts that are each fitted with two Washers before being screwed into Threaded Bosses. The Contrate carries three $\frac{3}{4}''$ Bolts, each fitted with a Collar and two Washers, and screwed into the other ends of the Threaded Bosses. A $\frac{1}{2}''$ Pinion 5 is free to rotate on a Threaded Pin attached to the Bush Wheel. Three Washers are fitted on the shank of the Pin for spacing purposes, and a bolt attached to the Contrate engages the boss of the Pinion to prevent side play. The Pinions 4 and 5 are in constant mesh.

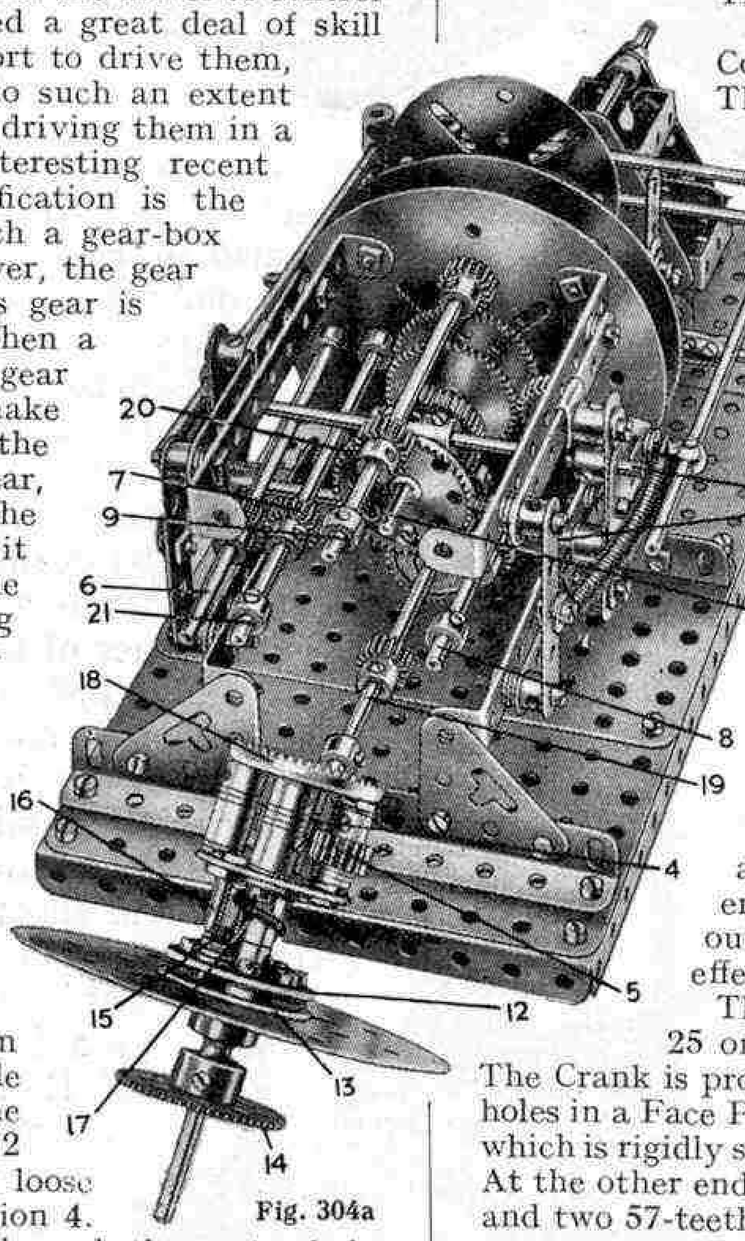


Fig. 304a

A $6\frac{1}{2}''$ Axle Rod 2 is passed through the Boss of the Contrate 18 and its end is inserted into the Pinion 4. This Rod is fitted with the $2\frac{1}{2}''$ Gear 11 (Fig. 304), a 57-teeth Gear, a 50-teeth Gear and also a 1" Gear. A Contrate 20 is free on the Rod and is secured to two Couplings on a pair of transverse Rods 22. These Rods control the sliding movement of the Contrate and are held at their ends in Double Arm Cranks attached to Flat Trunnions. Two Eye Pieces are fitted to each pair of Cranks as shown, and slide on $3\frac{1}{2}''$ Strips spaced from the sides of the gear box by three Washers on each fixing Bolt. Normally the Contrate 20 is held in engagement with the Contrate 18 by Springs, but can be withdrawn by depressing the foot pedal 23, which is connected up by means of Axle Rods in the manner shown.

There are four lay shafts 8, 9, 21 and 19 (see Fig. 304a), each carrying a $\frac{1}{2}''$ Pinion. The Pinions are arranged so that the Pinion 5 can be brought into engagement with any one of them, and it is retained in mesh by the Contrate 18 engaging the fixed Contrate 20, which must be slid out of engagement before a gear change can be effected.

The selector can be seen from Fig. 304, the Crank 25 on an 8" Rod 10 being used for locating the gears. The Crank is provided with a $\frac{3}{4}''$ Bolt that engages the outer set of holes in a Face Plate. The Rod 10 is free to turn in the Face Plate, which is rigidly secured by a $\frac{1}{2}''$ Bolt to the end plate of the gear-box. At the other end of the Rod is a loose Collar, a Compression Spring and two 57-teeth Gears, mounted with their bosses outward. The Rod is slidable, so that the $\frac{3}{4}''$ Bolt on the Crank 25 can be withdrawn from engagement with the Face Plate and the Crank rotated to occupy another position. The movement of the Rod is limited by a second Collar that prevents the two 57-teeth Gears from moving out of mesh with the Gear 14. As the Gear 14 is turned, the Spring Cord 17 is stretched, but the Bush Wheel and Contrate 18 are prevented from rotating by the Contrate 20. As soon as this is withdrawn from engagement, the Spring Cord pulls round the cage with the planet Pinion 5 until the Pin 16 strikes the $\frac{3}{8}''$ Bolt 15. The position of the selector lever in relation to the Pinion 5 should be adjusted so that when the lever occupies one of the holes in the Face Plate the Pinion 5 is in mesh with the Pinion on one of the lay shafts. The Pinions are held in engagement by the Contrate 20 when the clutch pedal is released.

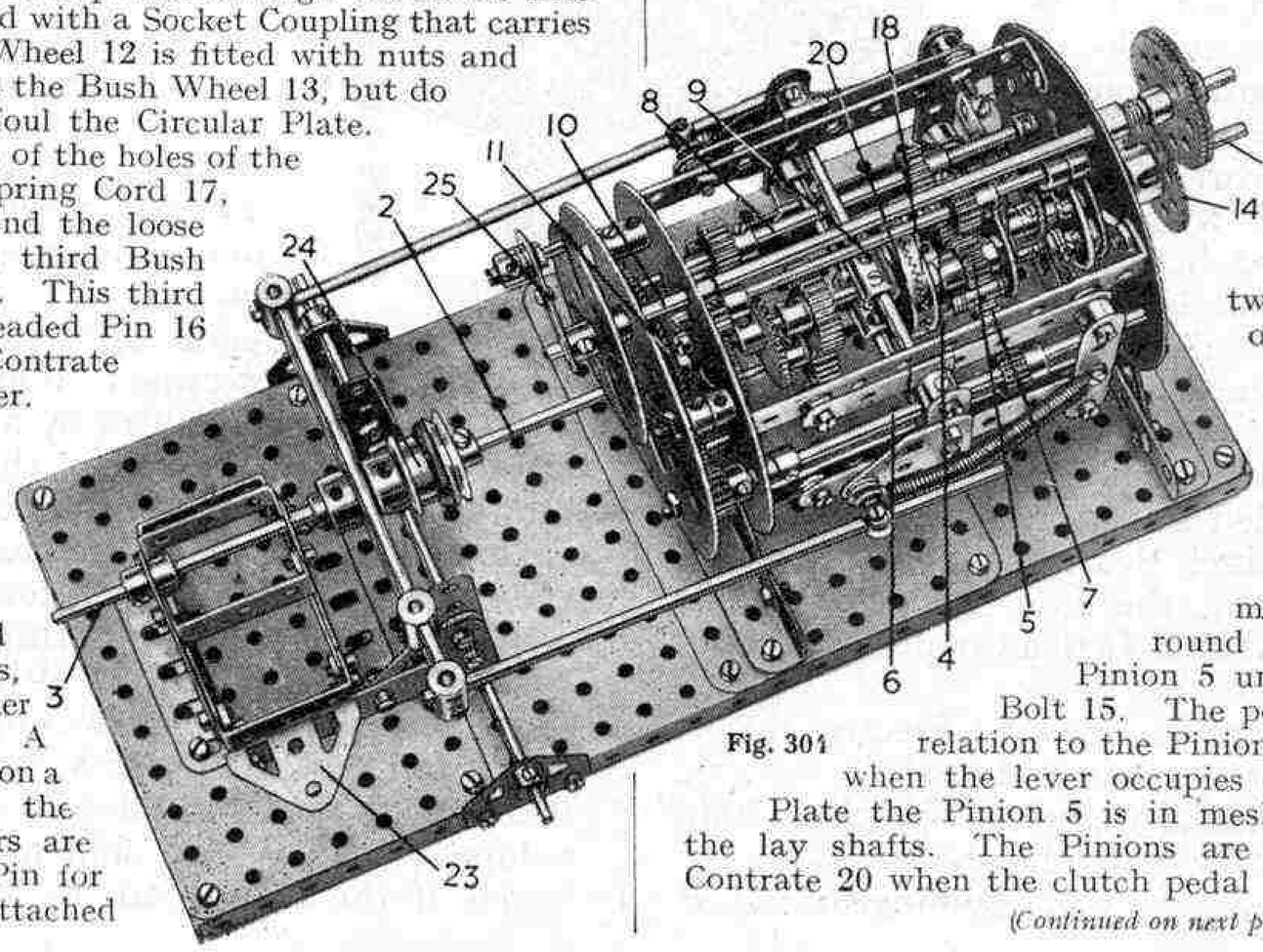


Fig. 304

(Continued on next page, Column 3)

(305)—Self-Tipping Skip (R. J. Andrews, Lancaster)

The outstanding feature of the model illustrated in Fig. 305 is that it automatically unloads as soon as it touches the ground. The model may be used in connection with cranes or aerial ropeways.

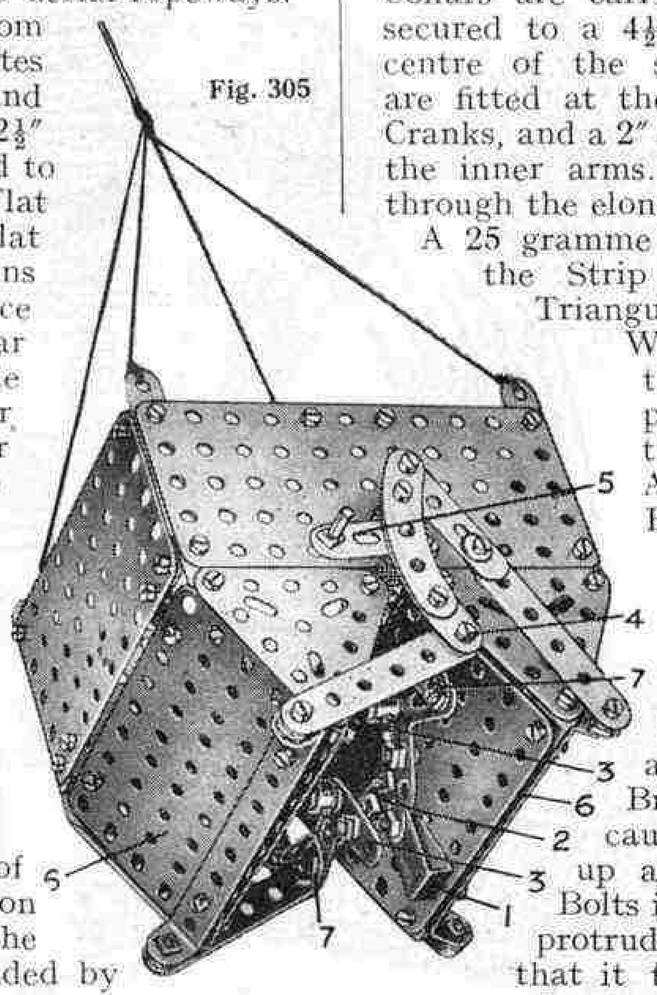


Fig. 305

The skip is built up from two 5½″×2½″ Flat Plates forming the sides, and each Plate has two 2½″ Triangular Plates secured to it. The ends of the Flat Plates have 4½″×2½″ Flat Plates attached by means of Angle Brackets to space them apart, and similar Plates are fixed by Angle Brackets at the inner edges of the Triangular Plates as shown. The Plates 6 are hinged by means of two Hinges on each, and carry 4½″ × ½″ Double Angle Strips along their lower edges.

The Double Angle Strips have pivoted at each end a 3″ Strip and one pair of these is also pivoted to the lower ends of 2½″ Curved Strips, one on each side of the skip. The Curved Strips are extended by similar parts, and the upper ends carry 2″ Slotted Strips to which the second pair of 3″ Strips is bolted. A Boss Bell Crank 5 is bolted to the Curved Strips on each side of the skip, and both Cranks are mounted on a Rod journalled in the side Plates. The Bell Cranks are provided with Threaded Pins for handles.

Two Simple Bell Cranks 3 are pivoted on ⅜″ Bolts gripped in Collars. The Collars are carried on 1″ Screwed Rods secured to a 4½″ Strip fitted across the centre of the skip. Angle Brackets 7 are fitted at the outer ends of the Bell Cranks, and a 2″ Strip 2 is pivoted between the inner arms. The pivots are passed through the elongated holes of the Cranks.

A 25 gramme Weight 1 is attached to the Strip 2 by means of a 1″ Triangular Plate.

When the skip is held in the normal position, suspended from the crane, the Weight 1 causes the Angle Brackets 7 on the Bell Cranks to move upwards. By depressing the handle 5, the flaps 6 are closed and the ¾″ Bolts 4 force down the Angle Brackets on the Cranks 3. As soon as they have passed the Brackets, the Weight 1 causes the Brackets to move up again and thus retain the Bolts in position. The Weight protrudes below the skip, so that it touches the ground first, and thus releases the Bolts 4. The weight of the material in the skip causes the flaps to open and release the contents without external handling, but the flaps must be closed by hand.

(306)—Automatic Clutch

(H. G. Brooke, Birmingham)

Electric Motors do not develop their maximum power until the armature shaft has picked up speed. The device shown in Fig. 306 ensures that the Motor has attained the necessary r.p.m. before transmitting the drive to the model. The Rod 1 is driven from the armature shaft through a ½″ Pinion and a 57-teeth Gear giving a 3 : 1 reduction ratio. A 1½″ Pulley 2 is secured on the Rod, which carries also a 1″ loose Pulley fitted with a Dunlop Tyre, and the 1½″ Pulley 3 which is free on the Rod. The Pulley 3 takes the drive to the model, and this is free to rotate on its Rod until it is pressed against the Dunlop Tyre forming a friction clutch.

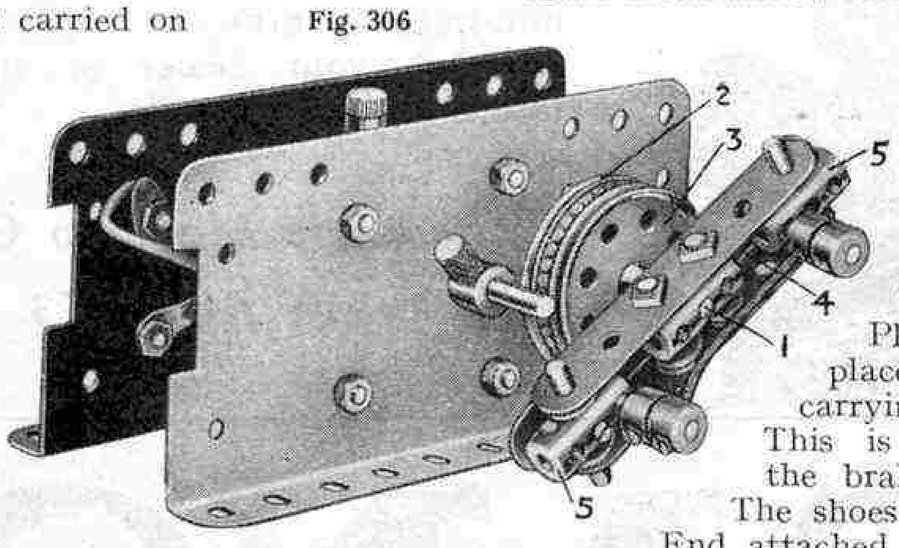


Fig. 306

A Coupling is carried on the end of the Rod 1 and has two 3″ Strips secured to it by means of ¾″ Bolts. Each Strip is spaced from the Coupling by two Washers, and a 3½″ Strip 4 is retained in place on the Rod between the two Strips. The Couplings 5 are carried on 1″ Axle Rods and are fitted with similar Rods, each carrying two Collars connected by Spring Cord.

When the Motor is started the Pulley 2 and the clutch operating mechanism rotate, but the Pulley 3 does not transmit the power. As the speed increases, the weights on the Couplings 5 fly outward and cause the friction clutch to engage.

(307)—Internal Expanding Brake

(L. F. Stiles, Chippenham)

An improved type of internal expanding brake is illustrated in Fig. 307. This closely conforms to actual practice, and is remarkably efficient in operation on account of the comparatively large frictional surface on the brake shoes. The brake shoes consist of 2½″ Strips 1, curved to fit inside a Boiler End, and bolted at one end to a Meccano Hinge. In their centre holes they carry Threaded Pins that are free to slide in Handrail Supports 2 pivoted to the Face Plate on which the brake is mounted. The outer ends of the shoes carry Angle Brackets between which is a Collar 3 with a Threaded Pin screwed into one of its tapped bores. The Pin is passed through the Face Plate and retained in place by a second Collar carrying the ¾″ Bolt 4. This is connected up to the brake operating lever. The shoes fit inside a Boiler End attached to the road wheel. When the Collar 3 is turned the shoes are expanded and the bolt heads press on the inside of the Boiler End, thus retarding its rotation. The shoes are normally held in the "off" position by a length of Spring Cord, the ends of which are attached to the bolts adjacent to those fixing the Hinge. In the centre the Cord is fixed to the Face Plate by a nut and bolt.

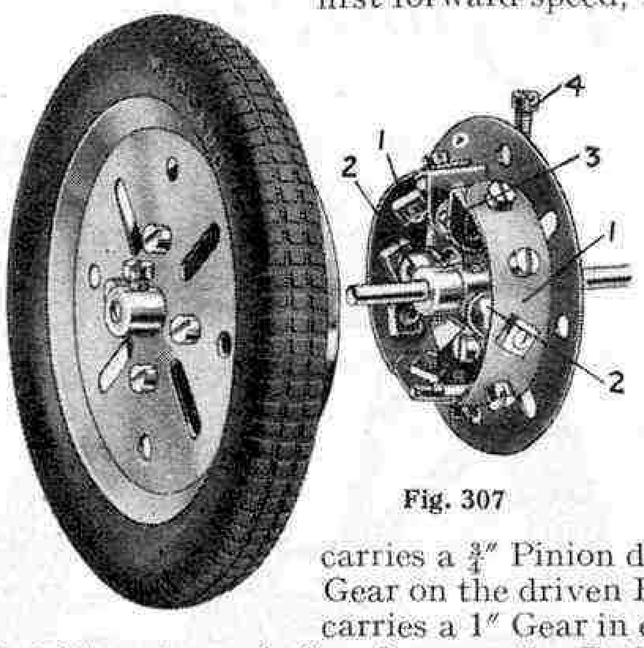


Fig. 307

Miscellaneous Suggestions

(M.170.) Improvised Ball-Cock.—S. F. Desai (Bombay, India) has found another practical use for Meccano parts. His idea is for a ball-cock controlling the amount of water flowing into a cistern so that it does not fill above a certain level.

The end of the pipe feeding the cistern is bent vertically downward and a clamp formed from Strips is fixed to the pipe before the bend and extends below the open end. At its lower extremity the arm carrying the float or "ball" is pivoted. Two 7½″ Strips are used for the arm, these being spaced apart by Washers, and at their outer end the float is fixed by forming a clamp from a 12½″ Strip. A tin box with a tight-fitting lid should be used for the float, and the lid should be placed uppermost to avoid the possibility of leaks.

A 2″ Screwed Rod is fixed at right angles to the arm at the inner end, so that when the arm is in the normal horizontal position the Screwed Rod is vertical and in a line with the centre of the bent over portion of the pipe. The tap washer consists of a soft eraser, cut to shape, and fitted above a 1″ Pulley on the Screwed Rod.

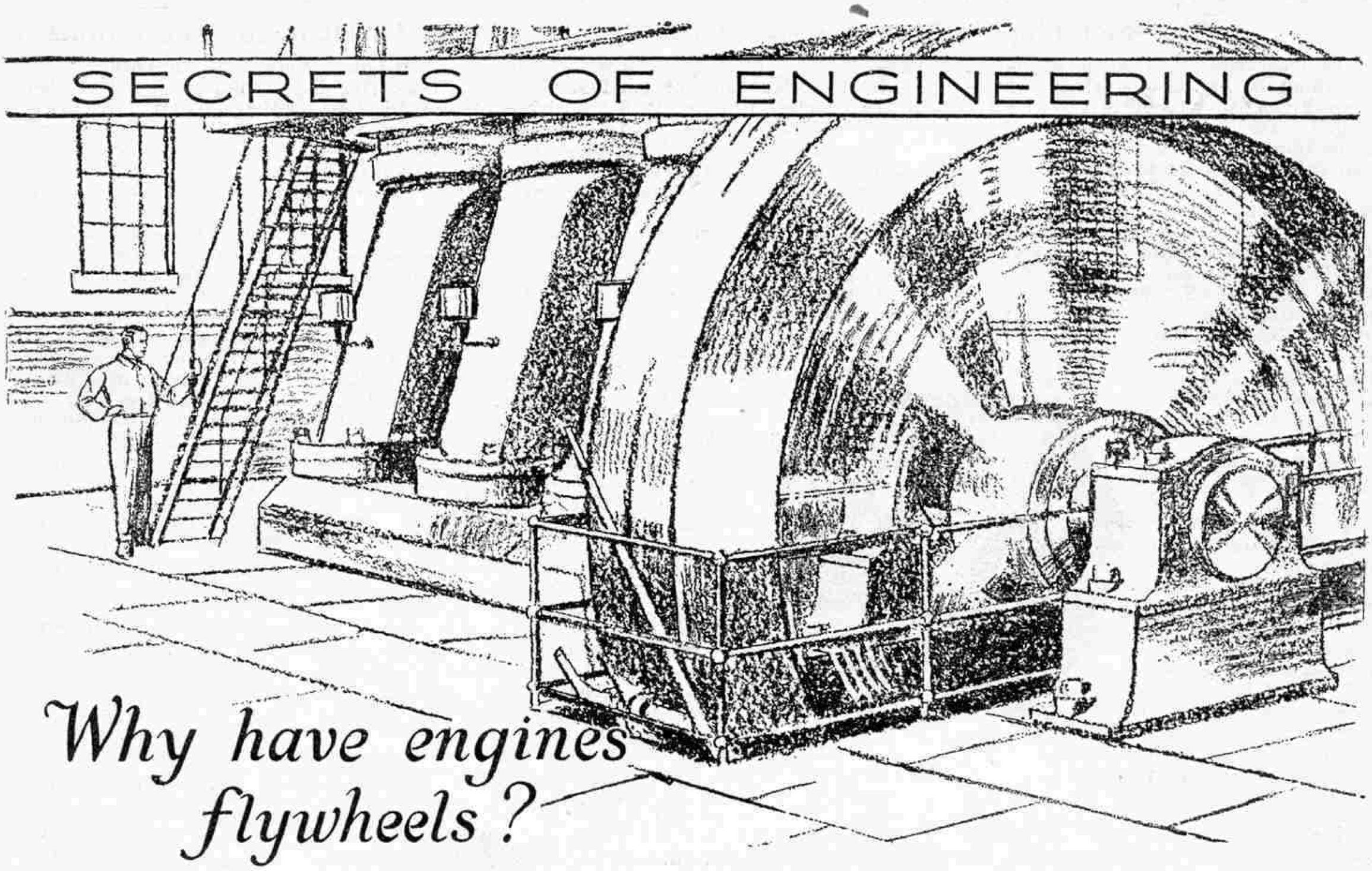
It will be found advisable to give the whole a coat of Meccano Enamel if it is to remain in use for some time, and a liberal coating of Graphite Grease should be applied to the pivot of the arm.

Pre-Selector Gear-Box—(*Continued from p. 230*)

The gear trains are as follows. For first forward speed, Pinion 5 engages Pinion 20 on the Rod 9. This Rod carries a second ½″ Pinion that is in mesh with a 57-teeth Gear on the driven shaft. For second speed, the Pinion 5 engages a ½″ Pinion on the Rod 8, which carries a ¾″ Pinion driving a 50-teeth Gear on the driven Rod. The Rod 19 carries a 1″ Gear in engagement with a similar Gear on the Rod 2, so that when the Pinion on the Rod 19 is engaged, the driving and driven Rods rotate at the same speed, for top gear. Reverse gear is engaged when the Pinion 5 is brought into mesh with the Pinion 7, which drives a similar Pinion on the Rod 6. The Rod 6 carries also a ½″ Pinion that is mounted between the two Circular Plates at the end of the gear-box. This can be seen in Fig. 304 and engages the 2½″ Gear 11.

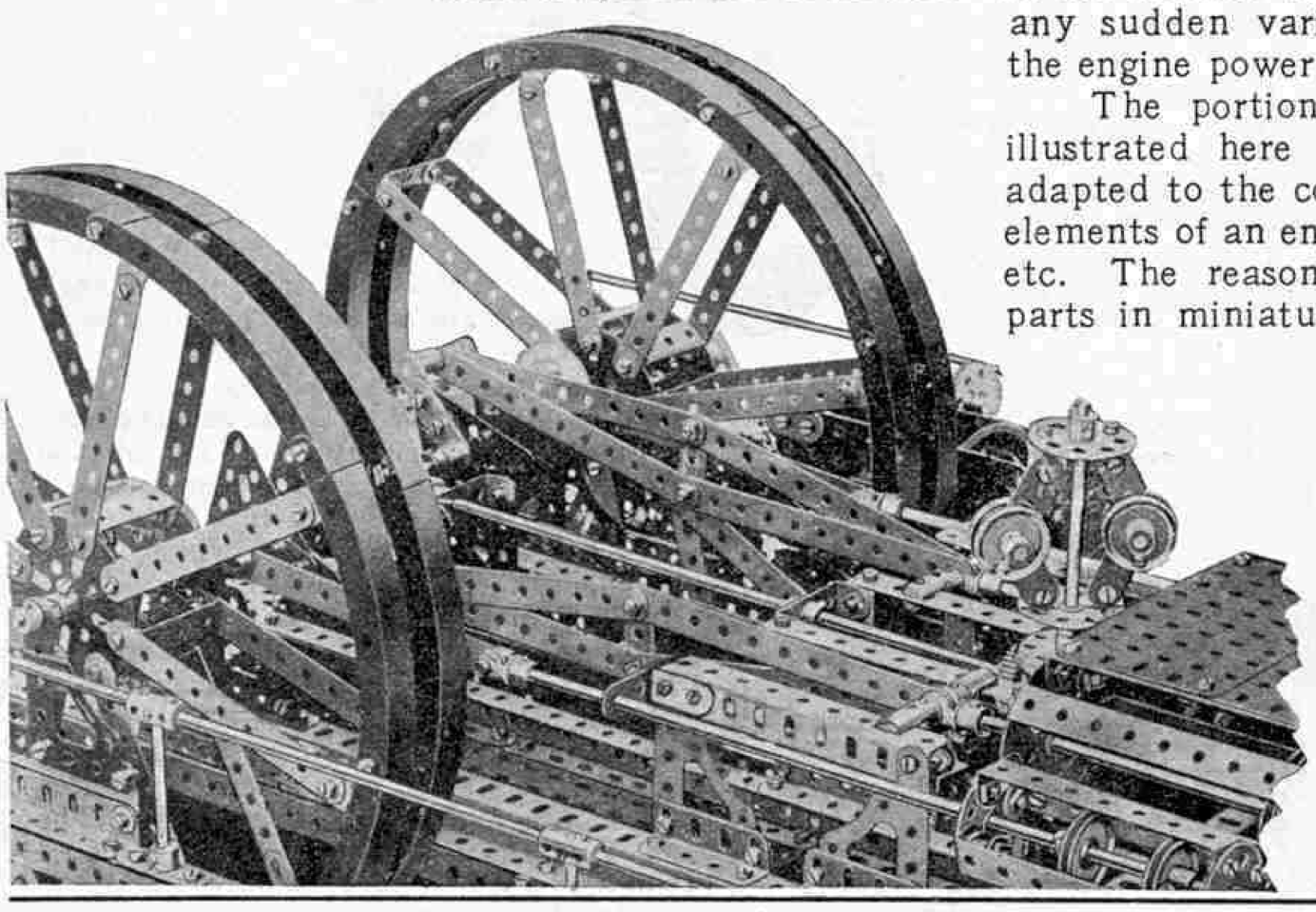
A friction clutch is incorporated between the Rods 2 and 3 so that the drive is taken up smoothly after changing gear. The Rod 2 carries a 1″ Pulley and a ½″ loose Pulley on which a ⅝″ Rubber Ring is fitted. A Socket Coupling carrying a ¾″ Flanged Wheel 24 is free to slide on, but rotates "solid" with, the Rod 3. A Collar on the latter Rod carries a Set Screw that engages the slot of the Coupling, and a Compression Spring cut down to about 1/3rd its normal length, is fitted between the two. Two Axle Rods engage the Selector groove of the Socket Coupling, and the clutch is disengaged simultaneously with the Contrates 18 and 20. Connecting rods link up the clutch and the Contrates

SECRETS OF ENGINEERING



Why have engines flywheels?

Many types of engines are provided with flywheels in order to distribute their power evenly. A rapidly spinning wheel tries to maintain a uniform speed and resists any force that tends to make it spin faster or slower. In this manner the flywheel of an engine prevents to a large extent any sudden variations in speed resulting from fluctuations in the engine power or in the load.



The portion of a Meccano Twin Cylinder Steam Engine illustrated here shows how effectively Meccano parts can be adapted to the construction of flywheels and to other important elements of an engine, such as centrifugal governors, crankshafts, etc. The reason is that Meccano parts are real engineering parts in miniature—they can all be used in exactly the same manner as the corresponding parts in real engineering practice. More important still, they are all standardised and interchangeable, and thus can be used to make hundreds of different engineering models.

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Meccano Model-Building Competition

Fine Prizes and an Equal Chance for All

This month we announce a new type of model-building competition in which owners of small Outfits have just as good a chance of winning prizes as more fortunate owners of large Outfits. In this contest competitors are asked to build models using only the selected Meccano parts shown in the panel on this page. All the parts listed are contained in Outfits from No. 3 upward. *The parts included in the list only may be used; no others may be added.* A Clockwork or Electric Motor, or a Meccano Steam Engine, may be used in models as a driving unit.

Competitors may build any kind of model they like best, but the more original a model is, the better will be its chance of winning a prize.

In this Contest all competitors, young or old, stand an equal chance of success, and all should make the best of this opportunity to win a big prize of Meccano goods, and so enlarge their stock of parts. Prizewinners will be allowed to select any goods they like from current Meccano or Hornby Train price lists.

Success in this Contest will be a good testimonial to a competitor's model-building skill, for it will show that he is capable of doing good work under definite conditions and with a limited number of parts. To build a prizewinning model under these conditions is a much more creditable performance than to construct a complicated model from an unlimited assortment and quantity of material.

The competition will be divided into three Sections as follows:—Section A, for competitors over 14 years of age living in the British Isles. Section B, for competitors under 14 living in the British Isles. Section C, for competitors of all ages living Overseas. The age of each competitor will be taken into consideration when judging the models.

The Prizes in each Section will be as follows:—First Prize: Meccano or Hornby Train goods to the value of £2-2s. Second Prize: Goods value £1-1s. Third Prize: Goods value 10/6. Ten Prizes of Goods value 5/–. Six Prizes of "*Famous Trains*" by C. J. Allen. Six Prizes of Meccano "*Standard Mechanisms*" Manuals.

Sections A and B will close for entries on 30th April, 1934, but Section C will remain open until 30th June, 1934.

The actual model must not be sent. A photograph or a good drawing is all that is required, but these should be as clear and detailed as possible. The competitor's age, name and address must be written *in block letters* on the back of each photograph or sheet of paper used, together with letter A, B, or C indicating the Section for which the entry is eligible. Competitors must send also a list of the parts used in their models.

Envelopes containing entries should be addressed "Selected Parts" Contest, Meccano Ltd., Binns Road, Liverpool 13.

Photographs or drawings of unsuccessful entries will be returned to the senders if desired, provided that a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs of prizewinning models become the property of Meccano Ltd.

Build Your Model with these Parts

4	of No.	1	1	of No.	27a
2	" "	2	1	" "	32
6	" "	3	8	" "	35
1	" "	4	64	" "	37
10	" "	5	4	" "	37a
2	" "	6a	12	" "	38
4	" "	8	1	" "	40
8	" "	10	1	" "	48b
4	" "	11	1	" "	52
12	" "	12	2	" "	53
1	" "	12a	4	" "	59
2	" "	15	2	" "	62
3	" "	15a	1	" "	63
2	" "	16	2	" "	90
2	" "	18a	2	" "	100
2	" "	20a	2	" "	111
4	" "	22	4	" "	111c
1	" "	23	2	" "	115
1	" "	24	1	" "	116a
2	" "	26	1	" "	147b

1 of No. 165

Prizes for Samples of Cloth Woven on the Meccano Loom

One of the most interesting and useful of the standard Meccano models is the fine Loom described and illustrated in Super Model Instruction Leaflet No. 16A. With this wonderful model real cloth can be made in various patterns and textures, but the beauty of the colour design and the quality of the cloth depends to a great extent on the manipulative skill of the weaver. Many hundreds of boys have built the Loom and no doubt have some pieces of cloth that they have made with it, and as we are interested in seeing these, we have decided to offer prizes for the best pieces sent to us.

It is not necessary to build the Loom specially to compete for the prizes. Any existing pieces of cloth that have been made in the past on a model now taken to pieces may be submitted. On the other hand, model-builders who have not yet built the Loom and wish to take part in the Contest, have time to build the model.

It is not necessary to send details or photographs of the Loom itself. Samples of fabric only are required. If possible two or three pieces of material of different patterns, colours and textures, should be sent.

The prizes will be awarded to the senders of the samples that the judges consider to be the most interesting as regard pattern and colour combination, and which show the best texture throughout. Samples should be big enough to enable the judges to estimate their merits correctly, and should be not less than 6 in. in length.

The prizes to be awarded are as follows:—First, Meccano or Hornby Goods value £1-10-0. Second, Goods value £1-1-0. Third, Goods value 10/6. Five prizes of Goods value 5/–.

The Contest is open to readers living in any part of the world, and there is no age limit. Samples of material should be carefully packed in an envelope, and forwarded to "Loom Samples" Competition, Meccano Ltd., Binns Road, Liverpool 13. *A sheet of paper bearing the sender's age, name and address must be attached to each sample of cloth sent in.* Samples of material may be submitted at any time before 30th June, 1934, but samples received after this date will not be considered.

It should be noted that samples of material entered in this Contest will not be returned to competitors.

New Meccano Models

Beam Engine — Flying Boat — Motor Truck — Tractor

THE earliest steam engines that met with any practical success were pumping engines of the beam type, in which a large horizontal beam was pivoted at the centre and connected at one end to the steam cylinder and at the other end to the pump. Later these engines were fitted with crankshaft and flywheel to give a rotary motion that enabled them to be used for numerous other purposes. Beam engines are still employed in some districts for pumping.

Fig. 1 illustrates a model showing the general characteristics of the beam engine. The base is built up by bolting 12½" Angle Girders across the ends of 5½" × 2½" Flanged Plates, and the supports for the beam are made from further 12½" Angle Girders, made rigid by diagonal 5½" Strips.

Two 12½" Angle Girders are connected at each end by Flat Brackets to form a channel section girder for the beam, which pivots on a 3½" Rod. Two 3½" Strips are also carried on the Rod and fitted at each end with 5½" Strips connected to the beam by Flat Brackets in the manner shown. Short Rods hold the Flat Brackets, and these carry the pivoted Strips connected to the piston rod and crank. The crank is formed from two Cranks bolted back to back, one carrying a 1" Rod forming the crank pin, and the other being fitted to the end of the 3½" Rod 3. This Rod carries two 3" Pulley Wheels and is journalled in a 1½" × ½" Double Angle Strip bolted to a Flat Trunnion that holds it rigidly to one of the Angle Girders of the frame. Twisting movement of the Angle Girder is prevented by the 5½" Strip 4. A flywheel is formed from four 5½" Strips, curved to form a circle and attached to the outer 3" Pulley by 2½" Strips, each of which is spaced from the Pulley by means of three Washers.

A 6-volt Electric Motor is mounted on two 3½" × 2½" Flanged Plates bolted between the two end Plates of the base. The Motor armature shaft carries a ½" Pinion that engages the 57-teeth Gear on the Rod 1, which carries at the other side of the Motor a 1" Pulley connected to a 3" Pulley on the Rod 2 by means of Cord. A 1" Pulley on the same Rod drives the inner 3" Pulley on the Rod 3. As the crank rotates, the connecting Rod 5 is caused to move up and down, thus oscillating the beam and transmitting movement to the piston Rod 6. This passes through the boss of a 2" Pulley Wheel fitted to four 2½" × ½" Double Angle Strips and representing the steam cylinder. A dummy valve chest is represented by a Sleeve Piece fitted at each end with a ¾" Flanged Wheel and fixed in place by two ⅜" Bolts.

The upper end of the Rod 6 carries an End Bearing that is connected to the beam by a 3½" Strip. A similar Strip is pivoted to an Angle Bracket nearer the centre of the beam, and the lower ends of both Strips are pivotally connected by a 2½" Strip. A connecting link formed from a 3½" Strip and a Reversed Angle Bracket is pivotally connected as shown between the inner Strip and a bracket secured to the frame. This arrangement of links is known as "parallel motion," and was invented by Watt. The upper end of the piston Rod moves in an approximately straight line instead of in an arc, as would be the case if it were pivoted directly to the beam.

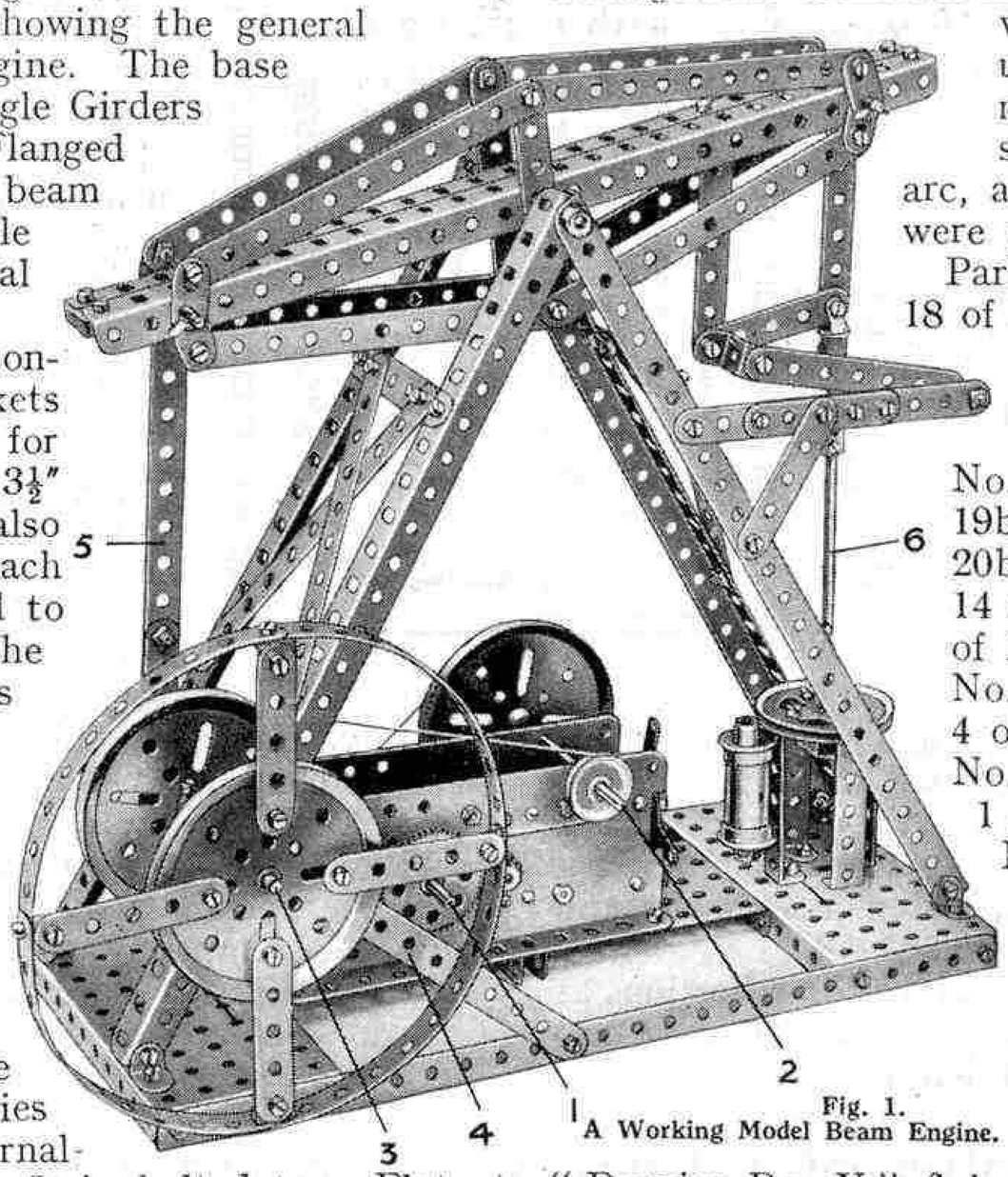


Fig. 1. A Working Model Beam Engine.

Parts required for Beam Engine :— 18 of No. 2 ; 6 of No. 3 ; 2 of No. 4 ; 9 of No. 5 ; 8 of No. 8 ; 8 of No. 10 ; 14 of No. 12 ; 1 of No. 15 ; 4 of No. 16 ; 2 of No. 17 ; 2 of No. 18a ; 3 of No. 19b ; 1 of No. 20a ; 2 of No. 20b ; 2 of No. 22 ; 1 of No. 27a ; 14 of No. 35 ; 90 of No. 37 ; 102 of No. 37a ; 14 of No. 38 ; 1 of No. 40 ; 1 of No. 45 ; 1 of No. 48 ; 4 of No. 48a ; 2 of No. 52 ; 2 of No. 53 ; 4 of No. 59 ; 2 of No. 62 ; 1 of No. 63 ; 1 of No. 111 ; 6 of No. 111c ; 1 of No. 125 ; 1 of No. 126a ; 1 of No. 163 ; 1 of No. 166 ; 1 No. 6 Electric Motor.

Dornier Flying Boat

The simple model illustrated in Fig. 2 represents the "Dornier Do. X" flying boat, which is the largest flying boat in the world, and can accommodate 169 passengers. The hull of the model is built up from Strips, spaced apart by means of Angle Brackets. A 2½" × ½" Double Angle Strip is bolted longitudinally between their upper edges, and to this the wings are secured. Three 12½" Strips form the main plane and are connected together across their ends by Flat Brackets.

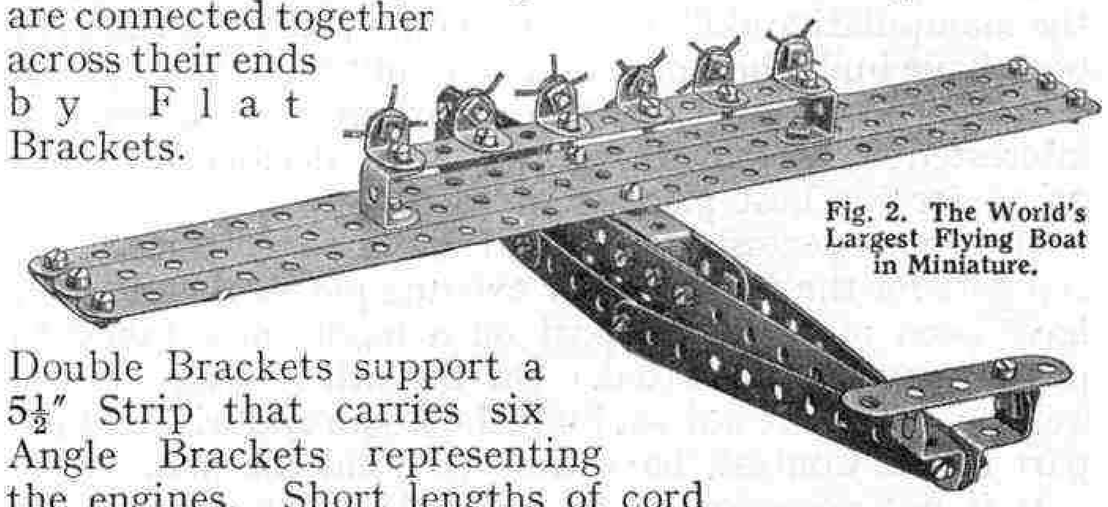


Fig. 2. The World's Largest Flying Boat in Miniature.

Double Brackets support a 5½" Strip that carries six Angle Brackets representing the engines. Short lengths of cord are fixed to the front of these Brackets by nuts and bolts carrying washers, and form the four-bladed propellers fitted to the actual machine.

Parts required for Flying Boat :—3 of No. 1 ; 7 of No. 2 ; 5 of No. 5 ; 5 of No. 10 ; 2 of No. 11 ; 8 of No. 12 ; 34 of No. 37 ; 3 of No. 37a ; 8 of No. 38 ; 1 of No. 40 ; 1 of No. 48a ; 3 of No. 111c ; 2 of No. 125.

Motor Truck

Power for the three-wheeled motor truck shown in Fig. 3 is provided by a No. 2 Clockwork Motor housed beneath the bonnet. A 12½" Strip is bolted along each side flange of a 5½" × 2½" Flanged Plate, and the width of the Plate is increased by fixing two 5½" Strips in place by means of Angle Brackets. At the forward end the long Strips are bolted to a 1½" × ½" Double Angle Strip, and two 2½" Strips are bolted vertically and extended by further similar Strips. These hold together five 5½" Strips that are bolted to transverse Strips at the rear. A Sector Plate forms the top of the bonnet, and is extended by four 2½" Strips bolted to a 2½" Curved Strip. The slot formed between these Strips accommodates the reversing lever of the No. 2 Clockwork Motor, which is mounted in position by means of four Reversed Angle Brackets.

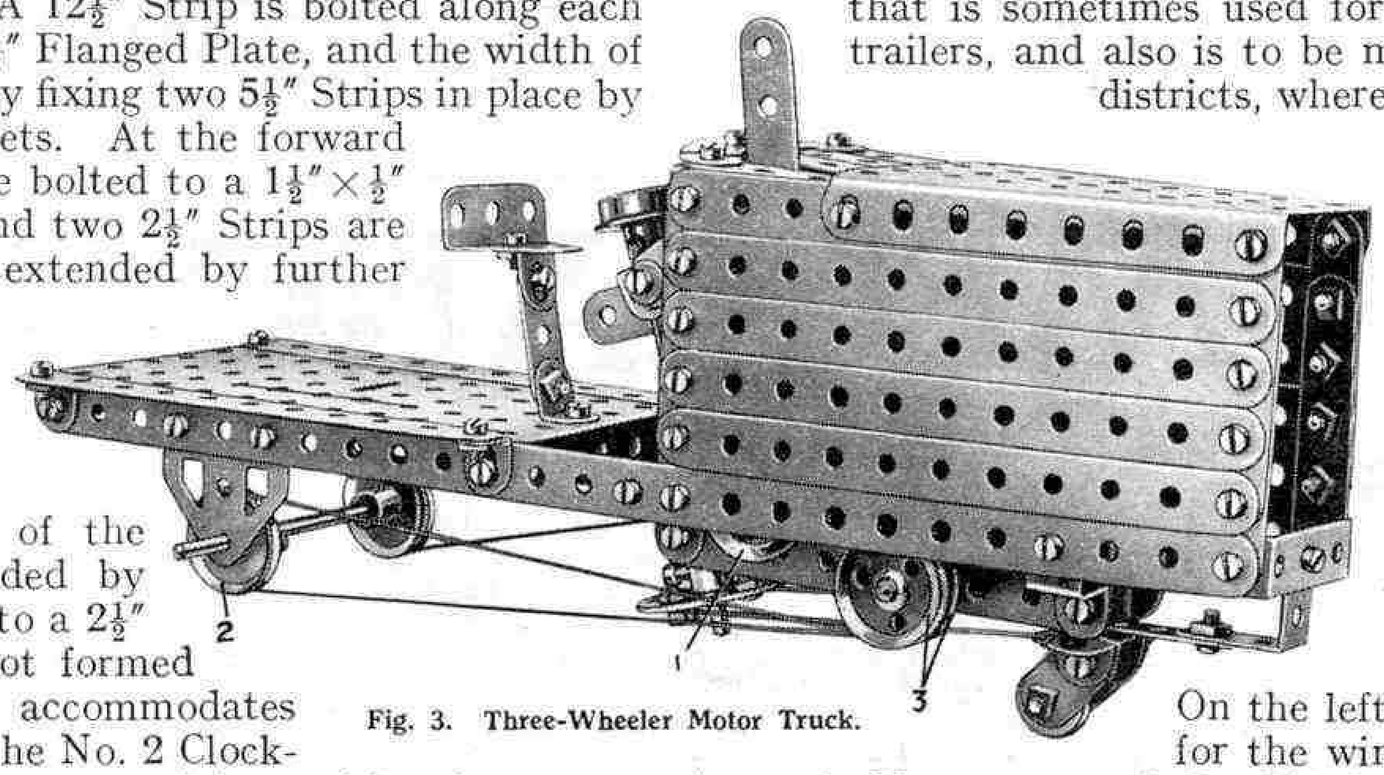


Fig. 3. Three-Wheeler Motor Truck.

The driving shaft of the Motor carries a 1" fixed Pulley, that is connected by a length of cord to a similar Pulley 2 on the rear axle. The Cord passes round the two 1" loose Pulleys 3, which act as guides. The second rear Wheel has a loop of cord passed round it, the ends of the cord being tied to the lower end of a pivoted 2½" Curved Strip, forming a brake lever.

The steering gear is operated by a ¾" Flanged Wheel on the upper end of the steering column, bearings for which are formed by an Angle Bracket attached by a Flat Bracket to the Motor, and also by an Angle Bracket at the lower corner of the Motor. A Bush Wheel on the lower end of the steering Rod is connected by two lengths of cord to the swivelling castor at the front of the model. This castor is made by bolting two Flat Brackets to a Double Bracket, the securing bolts holding also two Angle Brackets. A ⅜" Bolt is passed through the centre hole of the Double Bracket, and inserted in the boss of a Crank that is fixed in position between the Motor side plates by means of the two ⅜" Bolts holding the Reversed Angle Brackets, and screwed into the tapped bores of the Crank. The web of the Crank is attached by a 1" × 1" Angle Bracket to the Double Angle Strip at the front of the model.

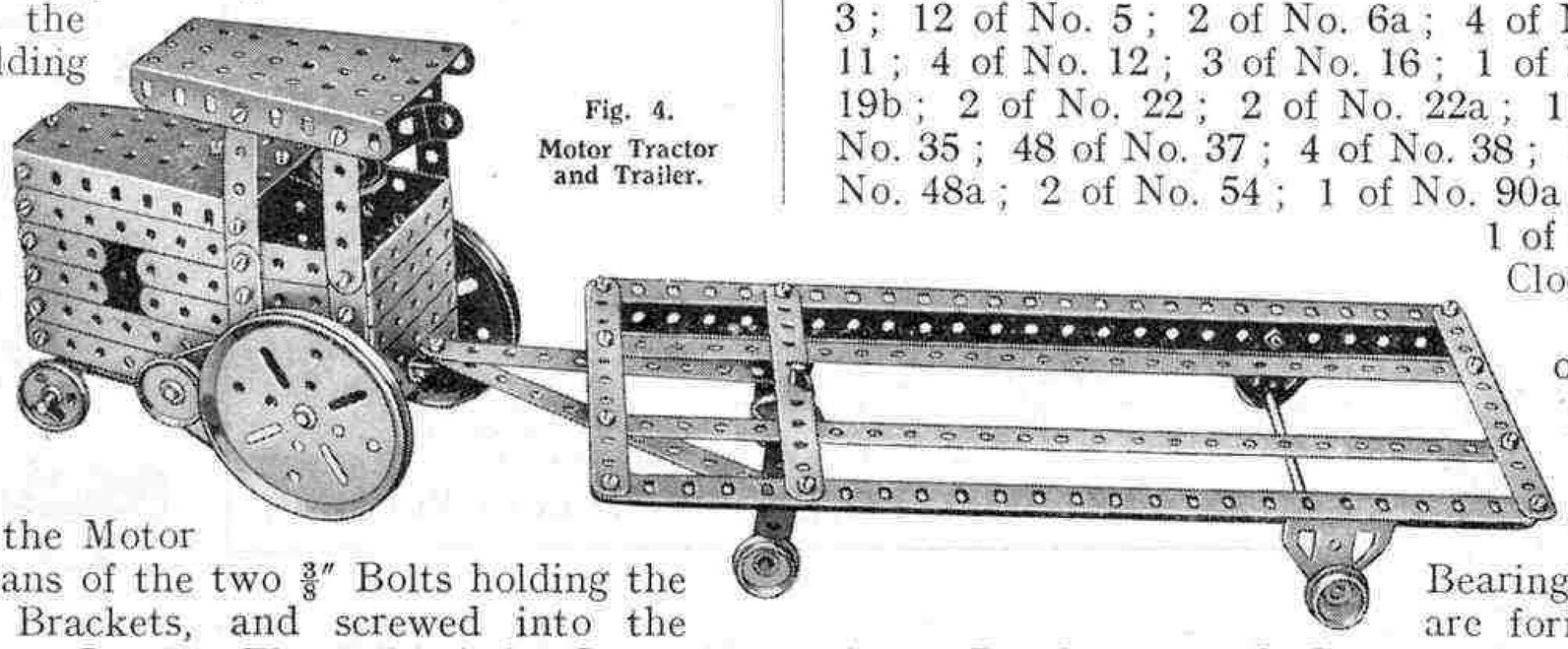


Fig. 4. Motor Tractor and Trailer.

A Trunnion forms the driver's seat, and is mounted on the upper end of a 1½" Strip by means of an Angle Bracket. The Strip is fixed to the Flanged Plate by means of a second Angle Bracket.

Parts required for Motor Truck :—2 of No. 1 ; 11 of No. 2 ; 2 of No. 3 ; 12 of No. 5 ; 1 of No. 6a ; 7 of No. 10 ; 1 of No. 11 ; 12 of No. 12 ; 1 of No. 12a ; 2 of No. 16 ; 1 of No. 17 ; 1 of No. 20b ; 3 of No. 22 ; 2 of No. 22a ; 1 of No. 23 ; 1 of No. 24 ; 2 of No. 35 ; 60 of No. 37 ; 5 of No. 37a ; 10 of No. 38 ; 1 of No. 40 ; 1 of No. 48 ; 1 of No. 52 ; 1 of No. 54 ; 1 of No. 62 ; 2 of No. 90a ; 6 of No. 111a ; 1 of No. 115 ; 4 of No. 125 ; 1 of No. 126 ; 2 of No. 126a ; 1 No. 2 Clockwork Motor.

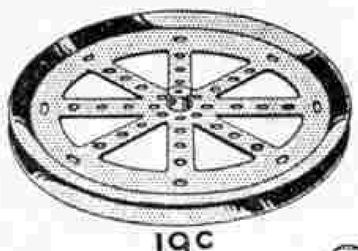
Tractor with Trailer

This model is of the petrol-driven type traction engine that is sometimes used for hauling heavily laden trailers, and also is to be met with in agricultural districts, where it is particularly useful for handling heavy machinery on rough ground. The model tractor and trailer are two separate units, but can both be built with the parts contained in a No. 2 Outfit. The sides of the tractor are formed from 5½" Strips connected across their ends by 2½" Strips. On the left-hand side a gap is left for the winding key of the Clockwork Motor, two of the 5½" Strips being replaced by 1½" and 3½" Strips. A Sector Plate is bolted to the top of the bonnet, and a Strip bolted down the front is secured to a Trunnion at the lower end. This part carries a 1½" × ½" Double Angle Strip pivoted by its centre hole and fitted with a 2" Rod carrying 1" loose Pulleys. A No. 1 Clockwork Motor is bolted in position by Angle Brackets and Double Brackets, and a 2" Axle Rod is substituted for the 1½" Rod supplied with the Motor. This 2" Rod carries a 1" Pulley Wheel that drives one of the rear Wheels. The rear of the tractor is filled in by means of 2½" × ½" Double Angle Strips, and the roof is formed from a Sector Plate supported on 2½" Strips. The 2½" Curved Strip that can be seen, is attached to the brake lever of the Clockwork Motor.

Parts required for Tractor :—8 of No. 2 ; 2 of No. 3 ; 12 of No. 5 ; 2 of No. 6a ; 4 of No. 10 ; 2 of No. 11 ; 4 of No. 12 ; 3 of No. 16 ; 1 of No. 17 ; 2 of No. 19b ; 2 of No. 22 ; 2 of No. 22a ; 1 of No. 24 ; 2 of No. 35 ; 48 of No. 37 ; 4 of No. 38 ; 1 of No. 48 ; 7 of No. 48a ; 2 of No. 54 ; 1 of No. 90a ; 3 of No. 111a ; 1 of No. 126 ; 1 No. 1 Clockwork Motor.

The construction of the trailer is simple and will be clearly understood from the illustration. Bearings for the front axle are formed from 1" × 1" Angle Brackets attached to a 5½" Strip, to which two further similar Strips are bolted to form the tow bar. Two 1" fast Pulleys carried on a 1" Rod are placed one above and the other below the 5½" Strip and clamped firmly against it. The Rod also passes through the centre of one of the transverse Strips on the trailer body, and is held by a Spring Clip.

Parts required for Trailer :—2 of No. 1 ; 2 of No. 2 ; 2 of No. 8 ; 2 of No. 12a ; 1 of No. 15 ; 1 of No. 15a ; 1 of No. 18a ; 4 of No. 20b ; 2 of No. 22 ; 1 of No. 35 ; 11 of No. 37 ; 4 of No. 38 ; 3 of No. 111a ; 2 of No. 126a.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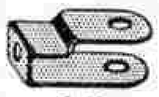
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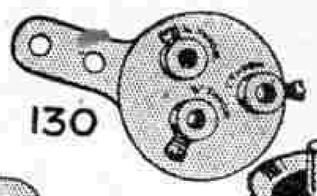
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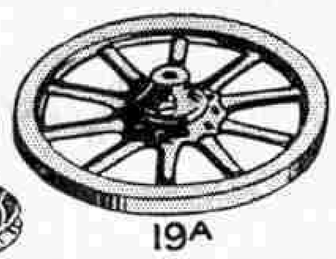
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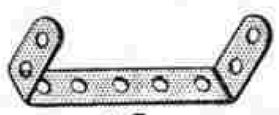
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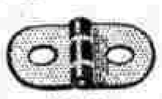
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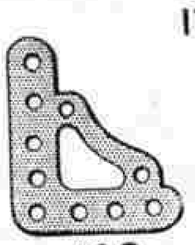
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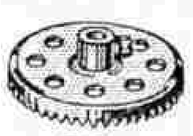
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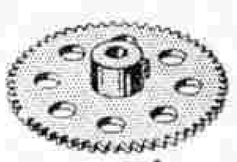
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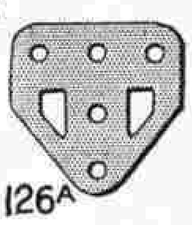
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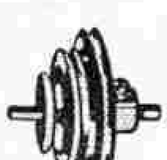
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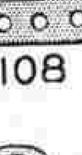
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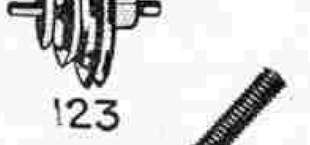
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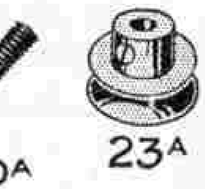
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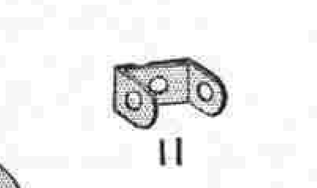
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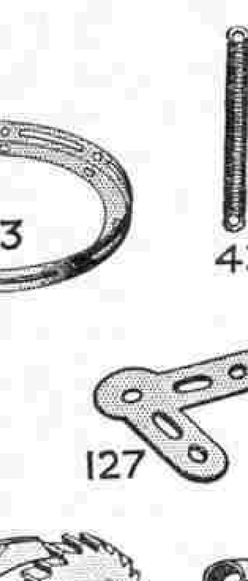
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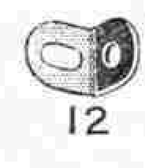
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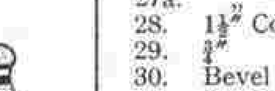
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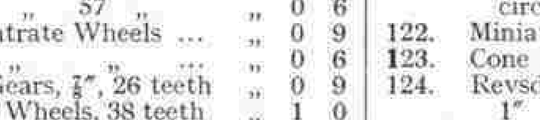
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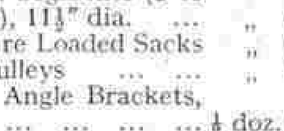
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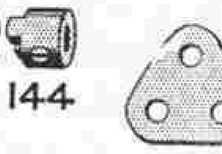
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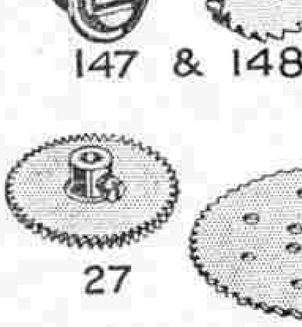
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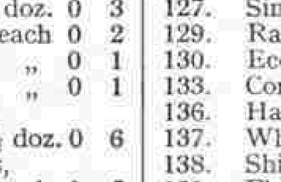
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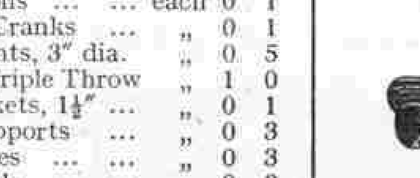
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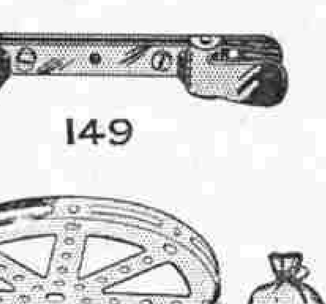
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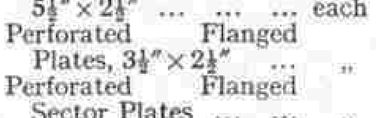
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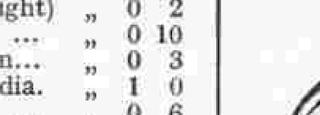
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MECCANO

Parts and Accessories

THE Meccano System is composed of some two hundred and fifty real engineering parts, mostly made of steel or brass, each one of which has a specified mechanical purpose. These parts combine to form a complete miniature engineering system, enabling practically any movement known in mechanics to be duplicated.

We illustrate a selection of Meccano parts that every Meccano boy will find useful in building the larger and more interesting models. Ask your dealer for a copy of the complete illustrated list of Meccano Parts and Accessories, and keep it by you for reference.

No.		s.	d.
9b.	Angle Girders, 3½" long ½ doz.	0	8
10.	Flat Brackets ... ... „	0	2
11.	Double Brackets ... ... each	0	1
12.	Angle Brackets, ½"×½" doz.	0	3
17.	Axle Rods, 2" ... ... 3 for	0	1
19a.	Wheels, 3" with set screw each	0	6
	Pulley Wheels		
19c.	6" dia. with centre boss and set screw ... ... „	2	0
22.	1" „ „ ... ... „	0	3
22a.	1" without set screw ... „	0	2
23a.	½" with „ ... „	0	3
26.	Pinion Wheels, ½" diam., ¼" wide ... ... „	0	4
27.	Gear Wheels, 50 teeth „	0	6
27a.	„ 57 „ „	0	6
28.	1½" Contrate Wheels ... „	0	9
29.	¾" „ ... „	0	6
30.	Bevel Gears, ⅞", 26 teeth „	0	9
31.	1" Gear Wheels, 38 teeth „	1	0
34.	Spanners ... ... „	0	2
35.	Spring Clips ... per box doz.	0	3
43.	Springs ... ... each	0	2
44.	Cranked Bent Strips ... „	0	1
45.	Double Bent Strips ... „	0	1
46.	Double Angle Strips, 2½"×1" ... ... ½ doz.	0	6
52.	Perforated Flanged Plates, 5½"×2½" ... ... each	0	5
53.	Perforated Flanged Plates, 3½"×2½" ... „	0	3
54.	Perforated Flanged Sector Plates ... ... „	0	3
61.	Windmill Sails ... ... 4 for	0	6
62.	Cranks ... ... each	0	3
63a.	Octagonal Couplings ... „	0	8
72.	Flat Plates, 2½"×2½" ... „	0	2
77.	Triangular Plates, 1" ... „	0	1
80a.	Screwed Rods, 3½" ... „	0	3
90.	Curved Strips, 2½", large radius ... ... „	0	1

No.		s.	d.
90a.	Curved Strips, 2½", small radius ... ... each	0	1
94.	Sprocket Chain per 40" length	0	6
95b.	Sprocket Wheels, 3" dia. each	0	6
96.	„ „ 1" „ „	0	3
99.	Braced Girders, 12½" „ ½ doz.	2	6
103d.	Flat Girders, 3½" ... „	0	7
104.	Shuttles, for Looms ... each	5	0
106a.	Sand Rollers ... ... „	1	9
108.	Architraves ... ... „	0	2
109.	Face Plates, 2½" dia. ... „	0	4
114.	Hinges ... ... per pair	0	4
116.	Fork Pieces ... ... each	0	3
118.	Hub Discs, 5½" dia. ... „	1	3
119.	Channel Segments (8 to circle), 11½" dia. ... „	0	4
122.	Miniature Loaded Sacks „	0	2
123.	Cone Pulleys ... ... „	1	3
124.	Revsd. Angle Brackets, 1" ... ... ½ doz.	0	4
126a.	Flat Trunnions ... ... each	0	1
127.	Simple Bell Cranks ... „	0	1
129.	Rack Segments, 3" dia. „	0	5
130.	Eccentrics, Triple Throw „	1	0
133.	Corner Brackets, 1½" ... „	0	1
136.	Handrail Supports ... „	0	3
137.	Wheel Flanges ... ... „	0	3
138.	Ship's Funnels ... ... „	0	3
139.	Flanged Brackets (Right) „	0	2
140.	Universal Couplings ... „	0	10
142.	Rubber Rings, 3" rim... „	0	3
143.	Circular Girders, 5½" dia. „	1	0
144.	Dog Clutch ... ... „	0	6
145.	Circular Strips, 7½" dia. over all ... ... „	0	9
146.	Circular Plates, 6" dia. „	1	0
147.	Pawls, with pivot bolt and nuts ... ... „	0	3
148.	Ratchet Wheels ... ... „	0	6
149.	Collecting Shoes, for Electric Locos ... ... „	1	6

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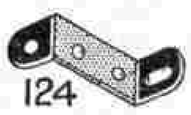
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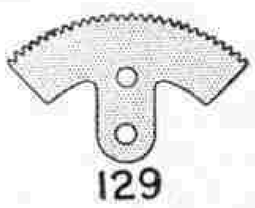
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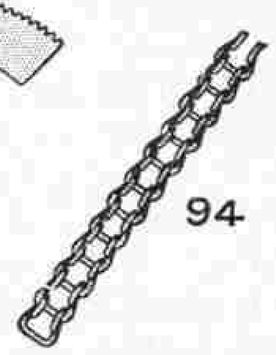
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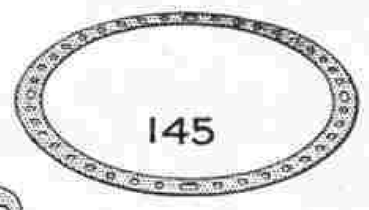
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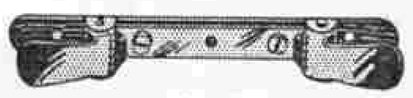
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22A

Model-Building Contest Results

By Frank Hornby

"Autumn" Contest (Home Sections)

The following are full lists of the prizewinners in Sections A and B of the "Autumn" Contest, full details of which were announced in the Magazine for October, 1933.

Section A (competitors over 14 years of age)

FIRST PRIZE, Meccano or Hornby Goods value £3-3s.: J. Nowlan, London, E.14. SECOND PRIZE, Goods value £2-2s.: D. Young, West Croydon. THIRD PRIZE, Goods value £1-1s.: D. Gage, Banbury.

FIVE PRIZES of Goods value 10/6: A. Bradfield, London, N.W.11; W. Bracher, Winchester; D. Drinkall, Grimsby; D. Holloway, Squirrels Heath; H. Love, Belfast.

FIVE PRIZES of Goods value 5/–: H. Blades, Plymouth; E. Sharp and J. Hines, London, N.1 (Joint entry); H. Smith, Bolton; W. Thomas, Gorseinon, Swansea; D. Unwin, Cambridge.

PRIZES of "*Meccano Engineer's Pocket Books*": R. Bratherton, London, S.W.15; F. Clark, Canterbury; J. Edge, Blackpool; P. Edwards, Birmingham; R. Jarrett, Daventry; J. Kennett, Richmond; G. Ransom, Cowes, I.O.W.; S. Reid, Aberdeen; R. Richardson, South Shields; R. Venning, Bridgend; E. Wiblin, Oxford.

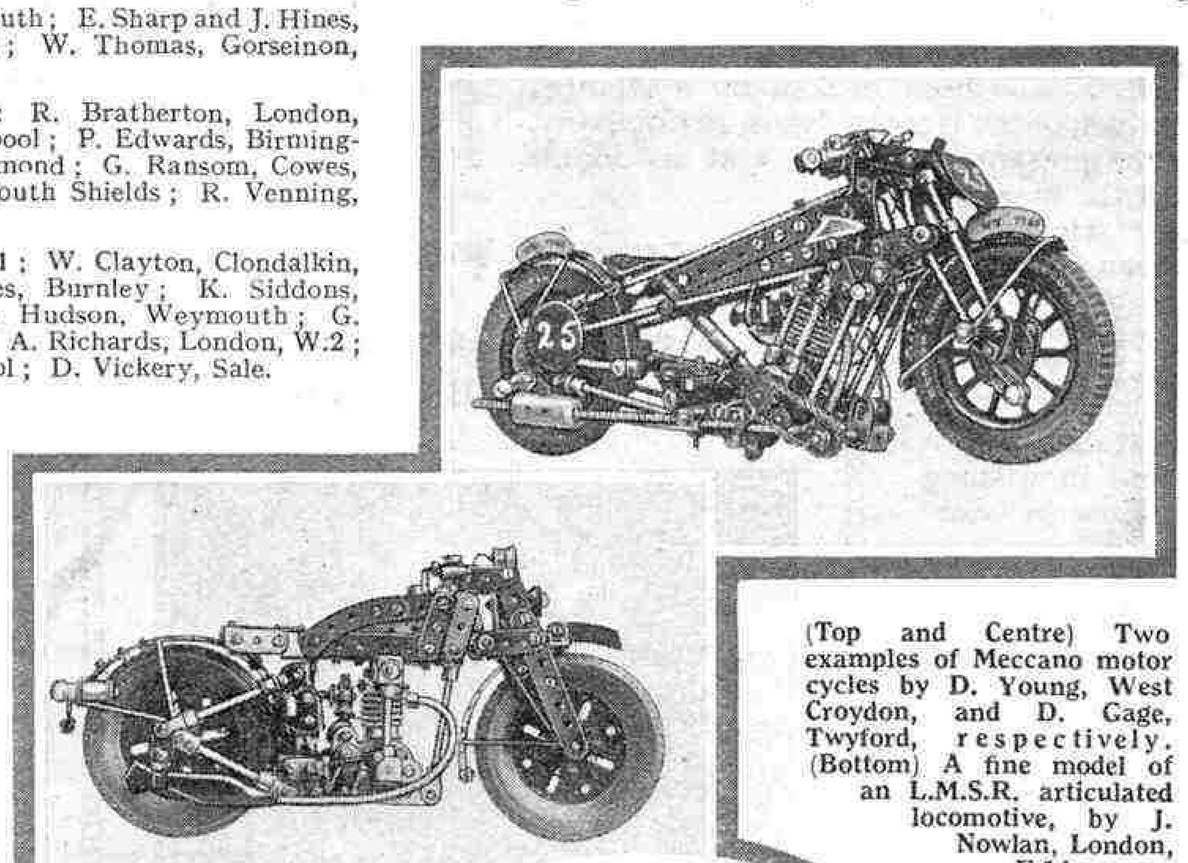
CERTIFICATES OF MERIT: R. Atter, Birmingham 11; W. Clayton, Clondalkin, Co. Dublin; E. Deakin, Coalville; W. Eaves, Burnley; K. Siddons, Woodbridge; R. Hogg, London, S.W.12; W. Hudson, Weymouth; G. Lieberman, London, N.W.2; A. McLeish, Perth; A. Richards, London, W.2; L. Sawtell, Sheffield 4; H. Stephenson, Liverpool; D. Vickery, Sale.

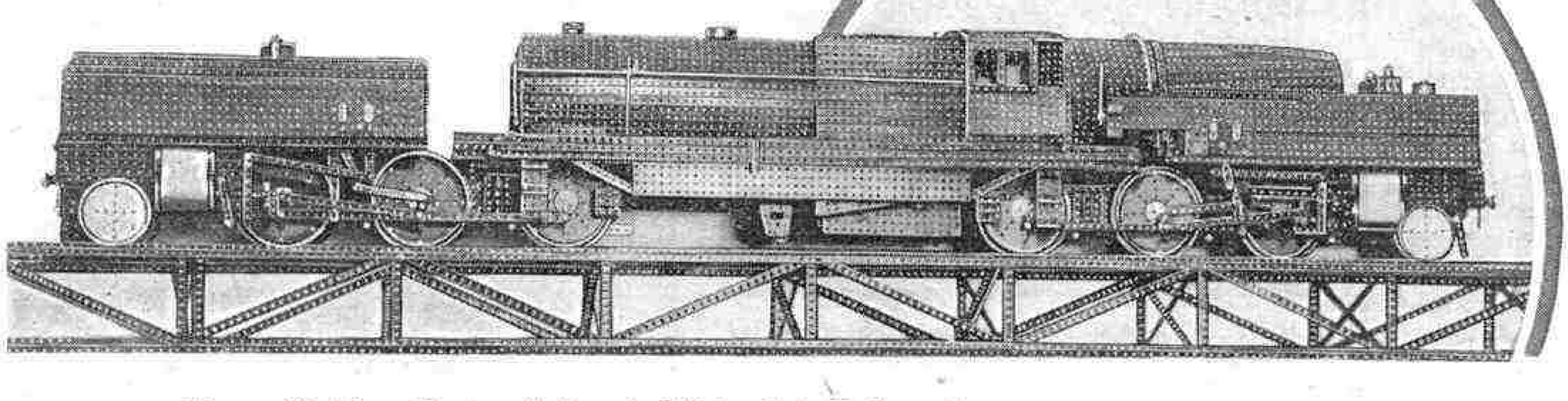
Section B (competitors under 14 years of age)

FIRST PRIZE, Meccano or Hornby Goods value £2-2s.: K. Parker, Leicester. SECOND PRIZE, Goods value £1-1s.: S. Ferguson, East Molesey, Surrey. THIRD PRIZE, Goods value 10/6: D. Fear, Taunton.

TEN PRIZES of Goods value 5/–: A. Bolton, Watford; R. Cuchway, London, E.5; A. Dabell, Stapleford; R. English, Parkstone; K. Pim, Exeter; R. Stephenson, Hull; J. Stone, Cambridge; C. Tidman, Hillingdon; C. Turner, Heavitree; J. Weir, Cardross.

PRIZES of "*Meccano Engineer's Pocket Books*": E. Brett-Harris, Weston-Super-Mare; A. Everett, London, S.E.25; J. Gubbins, Loughborough; D. Legg, Newtown, Exeter; D. Levy, London, E.10; E. Mead, London, S.E.18; V. Pullin, Bath; N. Ray, Benton, Northumberland; J. Sherrey, Bedford; P. Short, Brighton; R. Sheppard, Wembley Park; W. Watson, Peterhead.





(Top and Centre) Two examples of Meccano motor cycles by D. Young, West Croydon, and D. Gage, Twyford, respectively. (Bottom) A fine model of an L.M.S.R. articulated locomotive, by J. Nowlan, London, E.14.

CERTIFICATES OF MERIT: H. Adams, Exeter; B. Brough, Edinburgh 4; H. Burnett, Birmingham; G. Castle, London, N.10; P. Caudle, Birmingham; P. Franks, Guildford; B. Garwood, Lowestoft; J. George, Bordon, Hants.; D. Haines, Mitcham; P. Hoist, Hurst Hill, Nr. Bilston; H. Hutchings, Stoke-under-Ham, Somerset; H. Isaac, Newtown, Exeter; A. Malpas, Kirkcaldy; I. McKean, Sanderstead; R. McCall, Cork, I.F.S.; R. Newhouse, Birkenhead; D. Northrop, Harston, Cambs.; J. Peake, Launceston; J. Twyman, Orpington; K. Vose, St. Helens; P. Wales, Lowestoft; R. Yeo, Exeter.

J. Nowlan's entry is a very fine model of an L.M.S.R. articulated locomotive, and it possesses so many interesting features that I intend to describe it in detail in an early issue of the "*M.M.*" The following brief description, however, will give readers some idea of the construction of the model, and its outstanding points.

The model is built in three separate sections, the main boiler unit, the water tank, and the coal-trimmer. The chassis of the trimmer and the tank units are similar in construction and are made of Flat Plates, Angle Girders and Girders. They are each fitted with three pairs of large driving wheels, two pairs of these being carried by the main chassis and the other pair on an extension. At the outer end the chassis is fitted with a pair of bogie wheels and cylinders, which in the actual machine are supplied with steam from the central boiler, and are fitted with Walschaerts valve gear. The boiler unit is built in the same manner as that of an ordinary locomotive, and is supported on the extensions of the coal trimmer and water tank chassis already referred to.

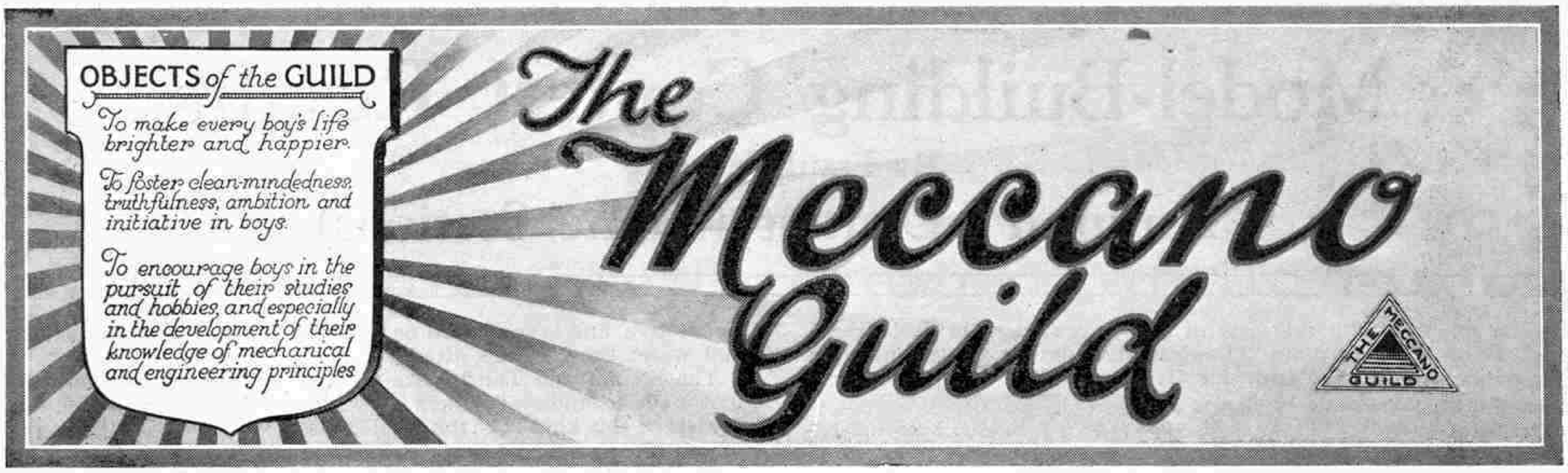
The Second and Third Prize models are both reproductions of motor cycles, and really there is little to choose between them. In models of this kind it is the small details that count, and for this reason Young's model was awarded the major prize. The framework is built entirely from Rods, but I think that the wheel-base is rather excessive, and there is insufficient ground clearance under the engine. The engine unit is interesting because of the realistic effect that has been obtained. The overhead valve gear, magneto, carburetter and gear-box are excellently reproduced, and are a fine testimonial to Young's skill. Other items of interest are the hub brakes, foot gear change pedal and the use of Spring Cord to represent mudguard stays.

D. Gage's model is perhaps the better of the two as far as proportion is concerned, but it does not incorporate much detail. In this model also Rods are used for the frame, but the tank alone constitutes the top tie bar. Points that detract from the merit of the model are the use of wire for mudguard stays, the fish-tail exhaust and silencer, which are not made from Meccano parts, and the exhaust pipe, which is made from a mutilated Rod.

In Section B of this Contest, First Prize was awarded to A. Parker, for an excellent model of a Parker Multi-Bucket Excavator. This model is to be described in a special article that will appear in the "*M.M.*" as soon as possible.

S. Ferguson, of East Molesey, won Second Prize with a realistic and well-built model of an early paddle steamer, the hull of which is made entirely of Strips, and the paddle-wheels from Hub Discs. Rods are used for the masts, and the sails are made from white paper. The model was photographed in appropriate surroundings, and was placed on a white cloth that was suitably creased to represent waves. In the photograph the model appears to be scudding along before a strong breeze, and the effect is very realistic.

Another good model is D. Fear's electrically-driven American 4–6–4 freight locomotive. It is built to a scale of 1/30th full size, and with a dead weight of 9 lb. is able to haul a load of 15 lb. at a speed of one mile per hour. Current for the Motor by which the model is driven is collected from an overhead cable by means of trolleys, the rails constituting the return conductor. The chassis is made of 12½" Angle Girders, bolted together with an overlap of 13 holes to form the main side members. These are suitably braced to make the whole quite rigid. The axles that support the main driving wheels are journalled in the elongated holes of a 6½" Flat Girder, which is formed by bolting together two 5½" Flat Girders. The leaf springs are 2½" Strips bent into the required shape and bolted in the appropriate position above each wheel; and the sides and roof of the model are made of Strips and Flat Plates.



Travelling 46 Miles to Club Meetings

From time to time interesting examples of the enthusiasm of members of Meccano clubs come to my notice, but I think that all records in this respect have been broken by a member of the Melbourne M.C. and Branch of the Hornby Railway Company. His home is 23 miles from the present club room, and his double journey of 46 miles to attend the meetings occupies more than 2¼ hours. He attends regularly, however, and even takes an active part in the conduct of the club, although he has only a limited amount of spare time at his disposal.

I am sure all members of the Guild will join with me in congratulating this member on his keenness, and in wishing him a long and profitable carcer in Guild and club work. There must be many others who make great sacrifices or face unique difficulties in order to join their fellow enthusiasts in the finest of all indoor hobbies, and I should be greatly interested to hear of them.

Essex Clubs Unite

Although there are few members of clubs in Great Britain who travel long distances in order to attend ordinary meetings, they show their keenness and enthusiasm in other ways, such as the close attention they give to the task of improving the fortunes of their own club and of other clubs connected with the Guild. A short time ago I received a very interesting communication from the secretary of the Clacton-on-Sea Club that provides an excellent illustration of this. It took the form of an account of a meeting between the chief officials of the Clacton-on-Sea, Harwich and Ipswich clubs. The meeting was held in Ipswich, the representatives of other clubs being the guests of the Ipswich M.C., and a wonderful day was spent in talking over ideas on the conduct of Meccano clubs, and in arranging to exchange lecturers and to hold joint excursions and meetings. It was agreed by all taking part in the discussion that their eyes had been opened to the possibilities of a Meccano Club. Every one present learned of new and interesting programme features that had been developed with success in one or other of the three clubs and they returned to their homes with the feeling that they were members of a great organisation and not merely individual units in a single club.

These activities on the part of clubs in Essex furnish excellent examples of the tendency of Meccano clubs to unite in the pursuit of their common interests. I hope that other clubs will adopt similar methods as far as possible, for mutual support of this kind cannot but strengthen the movement generally. Ambitious schemes, involving heavy expenses, are not necessary, and it must always be borne in mind that members should enter spontaneously into efforts of this kind if they are to be of real permanent value. In all probability more harm than good would follow efforts to force things on.

Meccano Club Leaders

No. 71. Mr. F. Broadbent, B.A.

Mr. F. Broadbent, B.A., has been Leader of the Whitgift School M.C. since its formation in 1928. The club was affiliated in the following year. Senior members undertake a large share of the executive work, and under the wise direction of their Leader the club has been increasingly prosperous and successful.

A Successful School Club

The growth of school clubs has been one of the most remarkable developments of recent years, and that established at Whitgift School, Croydon, is a typical instance of a successful club of this kind. It was founded in 1928, and affiliated in the following year, and Mr. F. Broadbent, Leader of the club, unhesitatingly gives credit for sterling pioneer work to J. D. Mellor, a pupil of the school who stirred up the enthusiasm that led to its formation and was an efficient and energetic secretary during its early days.

Mr. Broadbent and his supporters set out to give the club a foundation that would stand the test of time. The structure they have erected is certainly a good one, for the organisation they have devised gives the best members regular experience in executive work, and thus there is no lack of capable leadership under Mr. Broadbent's direction. The continuity of policy that this plan ensures is largely responsible for the success of the club, the prospects of which are steadily becoming brighter.

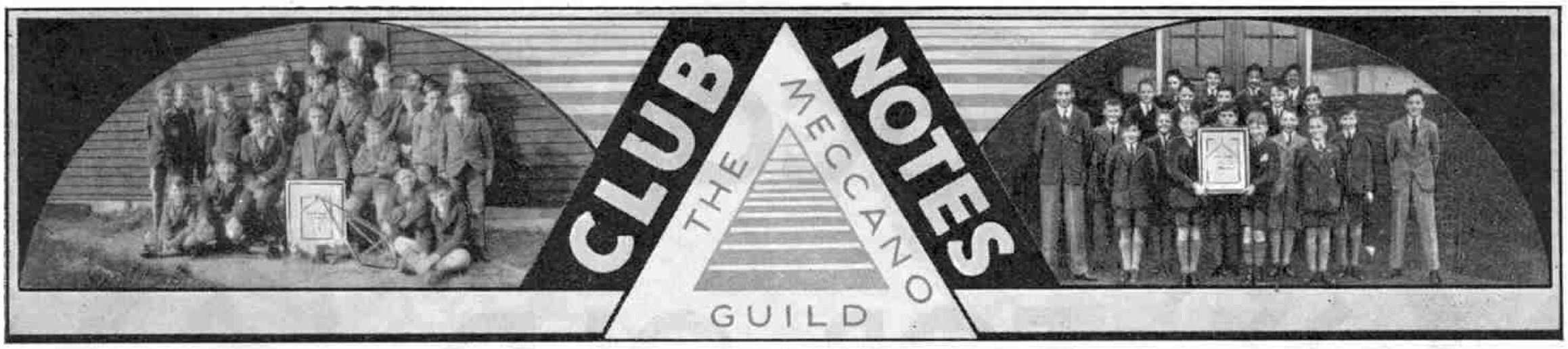
In club work importance is laid on regularity of meetings, and a strict timetable of meetings for Model-building, Lectures, Readings and Debates is followed. At least three visits to places of interest are arranged every term. One of these visits must be an excursion planned on a large scale, and on one occasion members travelled to Liverpool, where they visited the Meccano factory and inspected an ocean liner in the docks. Members are fortunate in being given leave of absence from school for extended visits of this kind, and for this privilege are indebted to Mr. R. Gurner, M.A., their President and Head of the School, who recognises the educational value of the club and gives it every support.

A feature on which Mr. Broadbent insists is that the club is not organised as a convenience for experts owning large outfits. These are welcomed, but the programmes are so arranged that beginners who possess small outfits also can enjoy themselves to the full, and the encouragement they receive has played a great part in the steady development of the club. The experts themselves recognise this and loyally support their Leader in all club activities.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places and boys interested should communicate with the promoters whose names and addresses are given below :—

BATH—Robert G. Bruce, 26, Milton Avenue, Wellsway.
BLACKPOOL—J. Riley, 69, Marsden Road, Blackpool S.
BLACKWOOD—J. Drew, 72, High Street.
CANADA—Mr. M. Hanley, 9715, 83 Avenue, Edmonton, Alberta, Canada.
CORSHAM—G. Dyke, Corner House, Church Street, Corsham, Wilts.
EDINBURGH—A. Fowler, 116, East Claremont Street.



Colwyn Bay M.C.—Model-building Evenings have been varied by Games and a Cinematograph Show given by one of the members. Carpentry and the building of wireless receivers also have been taken up, and members are keen on constructive work generally. Lectures and demonstrations of Meccano Super Models also are greatly enjoyed. Club roll: 8. *Secretary:* H. Thomas, "Summer Seat," Conway Road, Colwyn Bay.

Laindon (Essex) M.C.—A series of meetings was devoted to the construction of model motor cars and lorries in a special Model-building Contest. The winning model was an excellent representation of a sports car, and a motor omnibus was placed second. Work on the club track has been continued. A special test was held in order to find which members were most capable of running trains, marks being awarded for skill in starting, stopping and reversing locomotives, coupling and uncoupling coaches and other operations. Club roll: 14. *Secretary:* A. Schofield, "Highfield," Inverness Road, Laindon.

Whitgift Middle School M.C.—A record number of new members joined during last session, and every meeting was very successful. Special interest was taken in the Engineering Exhibition at Olympia, where members were almost bewildered by the wonderful array of machinery displayed. A visit to Southampton Docks aroused equal interest, and was greatly enjoyed by those who took part in it. Club roll: 51. *Secretary:* G. Cakebread, 12, Beech Road, Norbury, London, S.W.16.

Greenock Academy M.C.—The Junior Section is making great progress, membership increasing in a satisfactory manner. Greater skill is being shown in model-building, and the entries in the weekly displays secure high marks. A visit of special interest was paid to the foundry of the Aluminium Casting Co. Ltd., and the annual club visit to the Scottish Motor Show in Glasgow aroused enthusiasm among members, many of whom derived inspiration for further model-building efforts from it. Club roll: 62. *Secretary:* D. M. R. Steel, 25, Margaret Street, Greenock.

Ashburton M.C.—Splendid model-building work is being carried on, and members are Hornby Train enthusiasts and have developed interesting layouts. An Air Gun Shooting Tournament has also been held, and has proved popular. Club roll: 30. *Secretary:* G. Buckner, Ashburton School, Long Lane, Croydon.

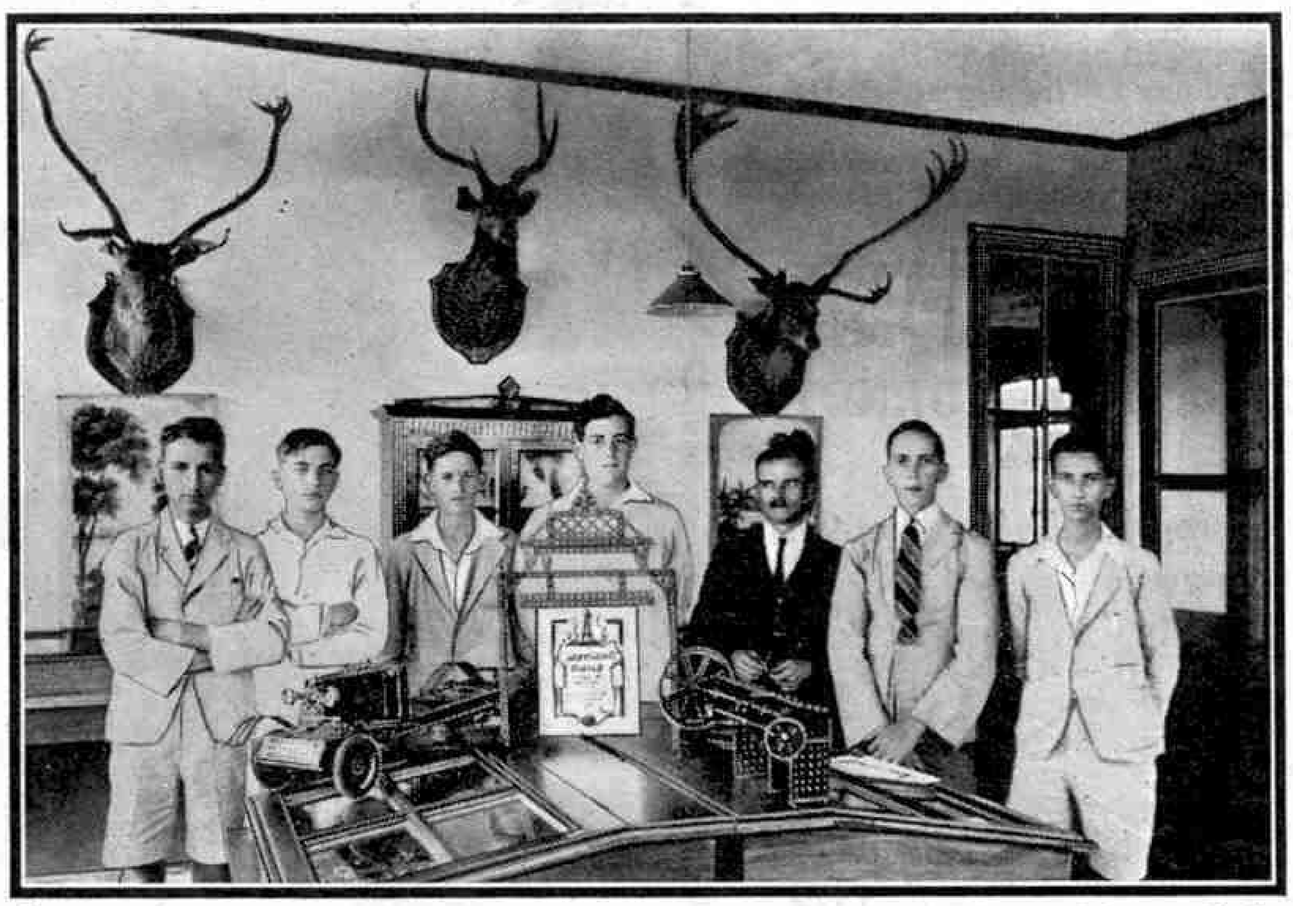
Ashby Grammar School M.C.—Weekly meetings are held for Model-building, and Lectures and other special events also are arranged. The Lantern Lectures given so far have included a series on the story of London, illustrated by means of slides showing features of interest in the City. Club roll: 40. *Secretary:* R. Scott, Boys' Grammar School, Ashby de la Zouch, Leicestershire.

New Bradwell M.C.—Table Tennis and Bagatelle are the chief games organised by members, and Winter Championship Contests have been arranged for both. Football also is played and interesting matches have been arranged with local clubs. At ordinary meetings Model-building is actively pursued and many interesting layouts have been tried by the Hornby Train Section. Club roll: 36. *Secretary:* R. Bellchambers, 29, King Edward Street, New Bradwell, Bletchley.

Glendale College (Westcliff-on-Sea) M.C.—Interesting models constructed have included an excellent display of working miniatures of machines, and a Bridge-building Contest has been held, many excellent entries being submitted. An interesting lecture on "*Gear Wheels*" was given by Mr. Gould, Leader of the Club. A Hornby Train layout has been prepared and is steadily being developed, operations on it giving much enjoyment to members. A "Two-Hour Model-building Contest" has been held, first prize being awarded to the constructor of a model workshop. A Library is to be started. A club bulletin is being issued. This is called "*The Cog*," and includes club news and items likely to be of interest to members. Club roll: 36. *Secretary:* D. Lake, Churston Meadway, Westcliff-on-Sea.

Dagenham M.C.—Successful meetings are being held and new members are required. Meccano boys interested should write to the secretary. The programme includes Socials and Open Nights in addition to Model-building Evenings, and a high standard of skill is now reached in the construction of models. Club roll: 25. *Secretary:* S. Pashley, 84, Holgate Road, Dagenham, Essex.

Plymouth M.C.—A particularly attractive Lecture on "*The Making of Model Aeroplanes*" was given by Mr. Rose, a famous model maker, who introduced members to several "tricks of the trade." The Annual Exhibition was an outstanding event. Many interesting models were constructed for this occasion by members, and visitors were particularly attracted by a model of a well-known Plymouth Tramcar Depot. A special issue of the "*Gear Box*," the club's magazine, was prepared for the Exhibition, and contained a coloured inset giving a plan of the Exhibition and a full programme. This was a great aid to visitors, and the club's enterprise was highly appreciated. Club roll: 65. *Secretary:* R. C. Job, 89, Foliot Road, Swilly, Plymouth.



A group of members of the Mauritius M.C. with M. Marcel Gaud, Leader, in the club room kindly placed at their disposal by the Principal of St. Joseph's College, Curepipe. Members are specially interested in large working models, and built the models shown in our photograph and many others for display at a very successful Exhibition.

Sid Vale M.C.—A special feature continues to be made of Model-building Contests in which entrants are asked to submit models of special types. Among the subjects set in recent contests have been aeroplanes, motor lorries, locomotives and trucks, bridges and ships. The Bridge Contest was particularly interesting. Tables were placed 2 ft. apart and suspension bridges had to be constructed across the intervening space, which represented a railway cutting. At this meeting juniors were specially catered for by a similar contest in which they had to produce any type of bridge. Club roll: 25. *Secretary:* R. Gliddon, Sheffield House, Sidmouth.

Stationers School M.C.—One of the members designed and constructed an automatic gear box, an account of which has been given in the School Magazine. Model-building meetings have been held regularly, and at these several enjoyable contests have been arranged. The Hornby Train Section also continues to develop, and interesting train working has been carried out. *Secretary:* R. J. Post, 8, Bourne Road, Crouch End, London, N.8.

Whitgift School M.C.—What are known as "Practical Meetings" are arranged regularly for Meccano and Hornby Train Sections. These form the central feature of the programme and attract the keenest interest among members. Other meetings have included a Lecture on "*Transport Through the Ages*," by Mr. Deacock, one of the masters of the school, and visits to the Fairfield Telephone Exchange and London Bridge Station, where the electric signal box was closely inspected. Club roll: 56. *Secretary:* H. J. Kirby, "Minniscot," Riddlesdown Avenue, Purley.

Kendal M.C.—The recent Annual Exhibition was as great a success as its predecessors. About 120 visitors were present, and many of them were delighted when allowed to operate the Hornby Train layout on view. The attractions included a Cinematograph Show, which was given several times to a "full house"; and a play that was performed six times to large audiences. Club roll: 15. *Secretary:* L. Haslam, Middleton, Kirkby Lonsdale.

CANADA

Westmount (Montreal) M.C.—Recent activities have included Fretwork, Wireless construction and readings from books and magazines in the Library, in addition to Model-building. Arrangements have been made to visit local works, and efforts are being made to introduce other hobbies in order to extend activities. Club roll: 22. *Secretary:* F. S. Thomson, 695, Grosvenor Avenue, Westmount, Montreal.

NEW ZEALAND

Petone M.C.—The Club's Annual Display was held in the Petone Memorial Technical College and was a magnificent success. Models built by members included a Meccanograph, which did good service in tempting visitors to part with coppers; and a large reproduction of the Forth Bridge, over which ran an extensive Hornby Train layout. Throughout the Exhibition members were kept busy explaining the working of the models to visitors, who were greatly interested in their efforts. The kind assistance given by the Principal of the Technical College during preparations for the Exhibition was very greatly appreciated. *Secretary:* C. Townsend, 79, Hutt Road, Petone, New Zealand.

SOUTH AFRICA

Malvern M.C.—A meeting that attracted special interest was a Social Evening open to parents and friends of members. The total attendance was 112, and prizes won during the session were presented by Mr. Epstein, Leader of the Berea M.C. This was followed by a presentation to Mr. E. Sykes, Leader of the club, in recognition of his splendid work on its behalf. Special meetings have been devoted to model-building practice and to the construction of models for the special Model-building Contest in connection with the Exhibition. The usual outdoor meetings have been held, Saturdays being devoted to special outings that are very popular with members. *Secretary:* C. D. Slade, P.O. Box 8, Cleveland, Johannesburg.

Western Province Preparatory School M.C.—At every meeting there is a large attendance of enthusiastic members, and it has become necessary to form sections, which are known by the familiar names of "Nuts," "Bolts" and "Washers." The chief prizes in the first Model-building Contest held by the club were won by the constructors of an electrically-driven Dockside Crane, and a Mechanical Shovel worked by means of two clockwork motors. In other contests entries were restricted to models of motor vehicles, aeroplanes and tanks. A Mock Trial has been held, and a Debate on the relative advantages of motor vessels and oil-burning steam ships resulted in defeat for those who upheld the virtues of steam. An "Impossible Train" Contest has been held, and the secretary remarks that the sharpness of members was well shown by the fact that out of 15 errors in the drawing employed, certain of them detected no fewer than 20. Club roll: 50. *Secretary:* B. B. Strickland, "Engwood," Doris Road, Claremont, Cape, S. Africa.

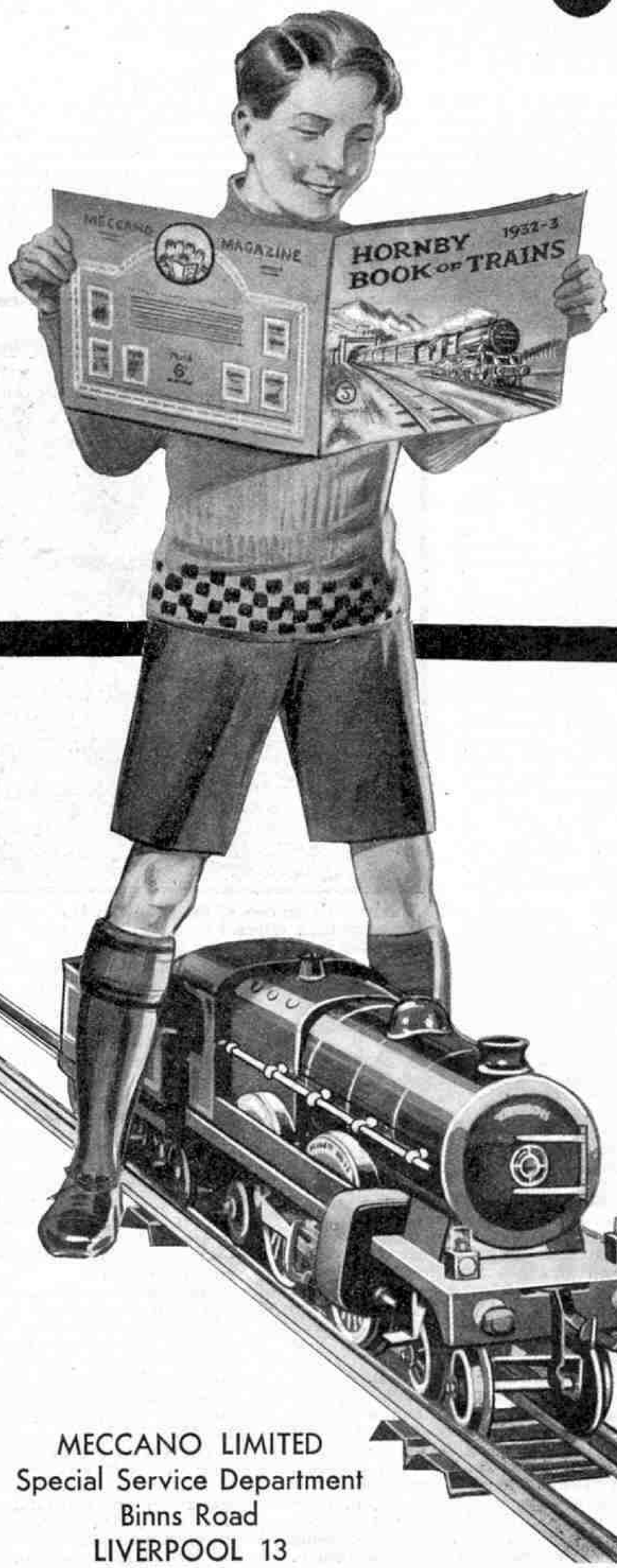
Club Not Yet Affiliated

Swansea Grammar School M.C.—Meetings are held twice a week. Members have constructed a large model workshop, each undertaking a special task, such as arranging the lighting system, painting and decorating the workshop, or building a machine for installation in it. A tour of Swansea Docks was made during the recent holiday. Model Aeroplane and Hornby Train Sections have been formed, and members of these are looking forward to excellent meetings. *Secretary:* H. Davies, 9, Monterey Street, Manselton, Swansea.

PRODUCT of MECCANO LIMITED LIVERPOOL

Hornby Locomotives are the Longest Running and Strongest Pulling Locomotives in the World

NEW LOCOMOTIVES FOR OLD



Boys ! Here is a plan to secure a fine new Hornby Locomotive in exchange for your old one.

First of all, study carefully the latest Hornby Train Catalogue, and select from it the new up-to-date Hornby Locomotive you want. Then pack up your old Hornby Locomotive and send it to us addressed " Special Service Department," Meccano Ltd., Binns Rd., Liverpool 13. Your order for the new Locomotive and the necessary remittance should be enclosed. You can easily ascertain how much to send by deducting the part exchange allowance indicated in the list given below from the price of the new Locomotive, and adding 1/– for postage on the new model you purchase. It is important to note that the catalogue price of the new Hornby Locomotive you purchase **must not be less than double the Part Exchange allowance made for your old Locomotive.**

If you prefer to do so, you can effect the exchange through your dealer, who will be very pleased to give you any information you require.

EXCHANGE YOUR OLD HORNBY LOCOMOTIVE TO-DAY !

Part Exchange Allowances for Hornby Locomotives

CURRENT TYPES	
MO Locomotive	1/4
M1/2 Locomotive	2/3
M3 Tank Locomotive	3/9
No. O Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
LEC 1 Locomotive (Swiss Type)	7/6
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
LST M3/20 Tank Locomotive (20-volt)	11/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
No. 1 Electric Tank Locomotive, Permanent Magnet	12/6
LST 1/20 Tank Locomotive (20-volt)	12/6
LE 1/20 Locomotive (Swiss Type), 20-volt	13/3
LE 2/20 Locomotive (20-volt)	16/6
No. 2 Electric Tank Locomotive	18/9
No. 3E Locomotive	18/9
No. 3E Riviera " Blue " Locomotive	18/9
No. 3C Locomotive	13/9
No. 3C Riviera " Blue " Locomotive	13/9
Metropolitan C Locomotive	11/3
Metropolitan L.V. Locomotive	20/-
OBSOLETE TYPES	
M2930 Locomotive	1/-
George V Locomotive (These models were identical)	3/3
No. OO Locomotive (These models were identical)	3/3
M3 Locomotive	4/3
Zulu Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 2 Locomotive	10/-
No. 2 Tank Locomotive	11/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	12/6
Metropolitan H.V. Locomotive	20/-

HORNBY TRAINS

MECCANO LIMITED
Special Service Department
Binns Road
LIVERPOOL 13

Branch News

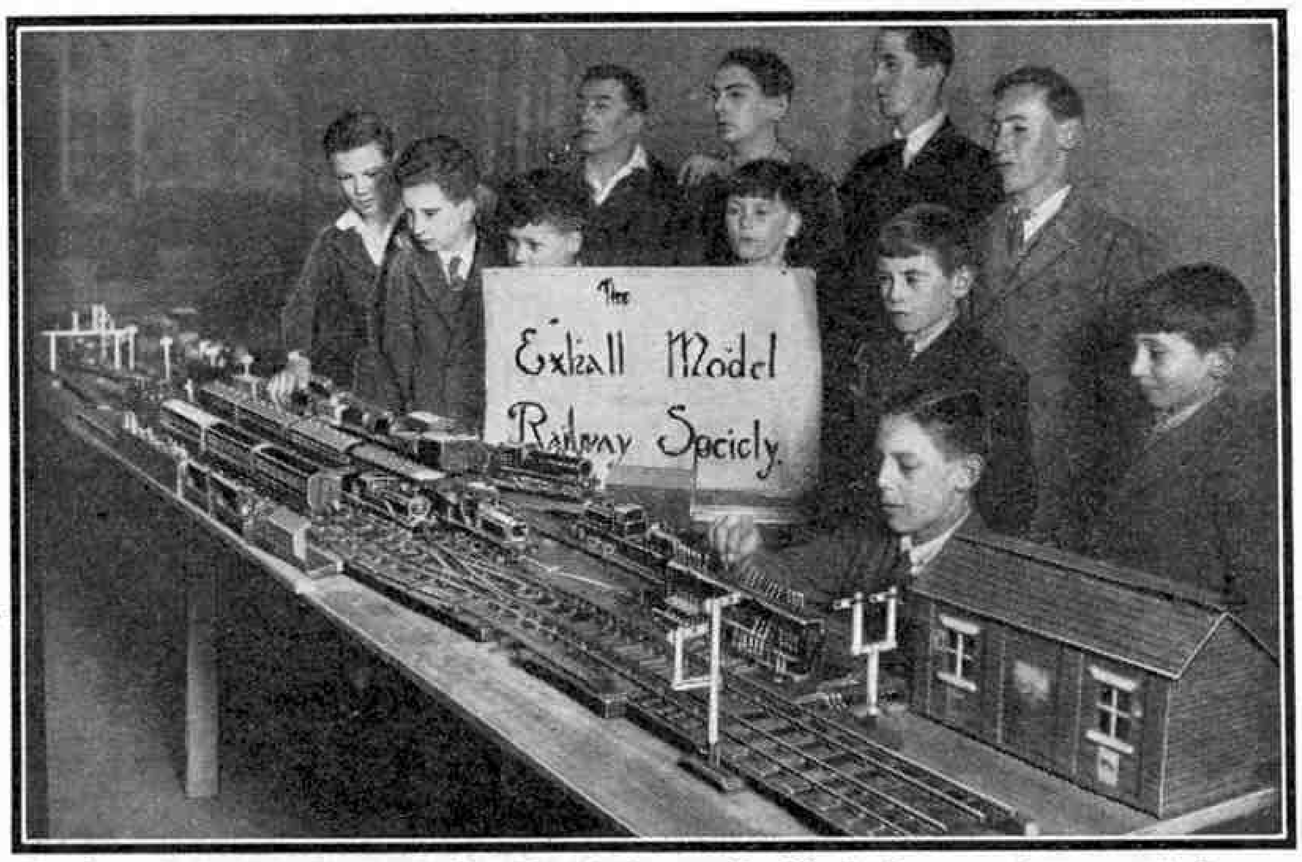
ALFRETON—A new track representing the main line of the L.M.S.R. (Midland Division) has been laid down. It is ballasted and correctly signalled throughout, and tests with express passenger and goods trains have proved satisfactory. Special attention is being given to the marshalling of trains. A Lecture on the L.N.E.R. was given by the secretary, and other events have included visits to local Signal Boxes and Locomotive Sheds. Secretary: A. T. Reid, 5, King Street, Alfreton, Derbyshire.

LORDSHIP LANE.—A special track has been designed for Exhibition purposes and a satisfactory timetable was worked out in practice. This track was in operation throughout the Branch's recent successful Exhibition. During a visit to the Old Oak Common Locomotive Sheds of the G.W.R. members closely inspected engines of the "King," "Castle" and "Hall" classes, and were interested in the massive electrical turntables, which were seen in operation. Secretary: R. Carrington, 49, Russell Avenue, Noel Park, Wood Green, N.22.

HARLESDEN METHODIST.—The track has been relaid and now consists of a main line with one branch. Part of it is carried on planks, and gradients have been provided in order to test the capabilities of the locomotives employed. A special feature is a well laid out triangle to enable engines to be turned, and a large turntable is included for similar purposes. Secretary: A. C. Durrant, 88, Burrows Road, Willesden, N.W.10.

WIMBORNE GRAMMAR SCHOOL.—Attention has been concentrated on operations on the Branch track, and members are becoming expert in arranging timetables and controlling trains. A motor train consisting of seven small coaches, in one of which an old locomotive engine has been fixed, has been constructed. This plan releases a locomotive for use on goods trains. Each month contributions towards the purchase of additional coaches are set aside. Three-colour light signals are being installed. Secretary: J. K. Bennett, 120, Newington Causeway, London, S.E.1.

WEST DULWICH.—Visits have been a prominent feature in the programme. These have included inspection of the coaling plant at King's Cross Engine Sheds, where members mounted the footplate of an L.N.E.R. "Pacific"; an excursion to Hadley Wood, where several famous L.N.E.R. express trains, including the "*Queen of Scots*" were seen; and the Zoo. Interesting track meetings also have been held. Secretary: F. Wesencraft, 321, Norwood Road, Herne Hill, S.E.24.



Members of the Exhall Branch, No. 12. Chairman, Mr. W. D. Garner; Secretary, F. Payne. This Branch was incorporated in January 1929, and interesting programmes have been followed. Special emphasis has always been laid on the importance of track operations, and our photograph shows part of an attractive layout designed for one of the Branch's successful Annual Exhibitions.

ILKESTON AND DISTRICT.—The track was dismantled and relaid after the club room had been cleaned and decorated. The new track was specially designed for the Branch Exhibition, at which the chief trains running were "*The Merseyside Express*" and an express goods train hauled by a Hornby No. 1 Special Tank Locomotive. The Breakdown Train stood by in the locomotive yard in readiness to deal with any derailments, but was not required. Secretary: F. B. Caddick, "Woodthorpe," Catherine Avenue, Ilkeston.

HOLLANDERS (SPALDING).—After many experiments an improved track has been designed. This is in the form of an oval with loops and sidings, and great skill is necessary in manipulating the 15 sets of points included in the layout. Timetables are continually being overhauled in order to improve the efficiency of working and to extend the services. Secretary: R. Sparling, 4, Gore Lane, Spalding.

AUSTRALIA

MELBOURNE.—Recent meetings have been held at the home at Northcote of Mr. L. Ison, Chairman of the Branch, while efforts were being made to find a new Branch room in a suburban district. Keen interest continues to be taken in train operation, and track work has been continued. Special meetings have been devoted to Games and Railway Knowledge Contests, and to demonstrations of Meccano models, including many of railway interest. Secretary: L. Ison, Lonsdale Street, Dandenong, Victoria, Australia.

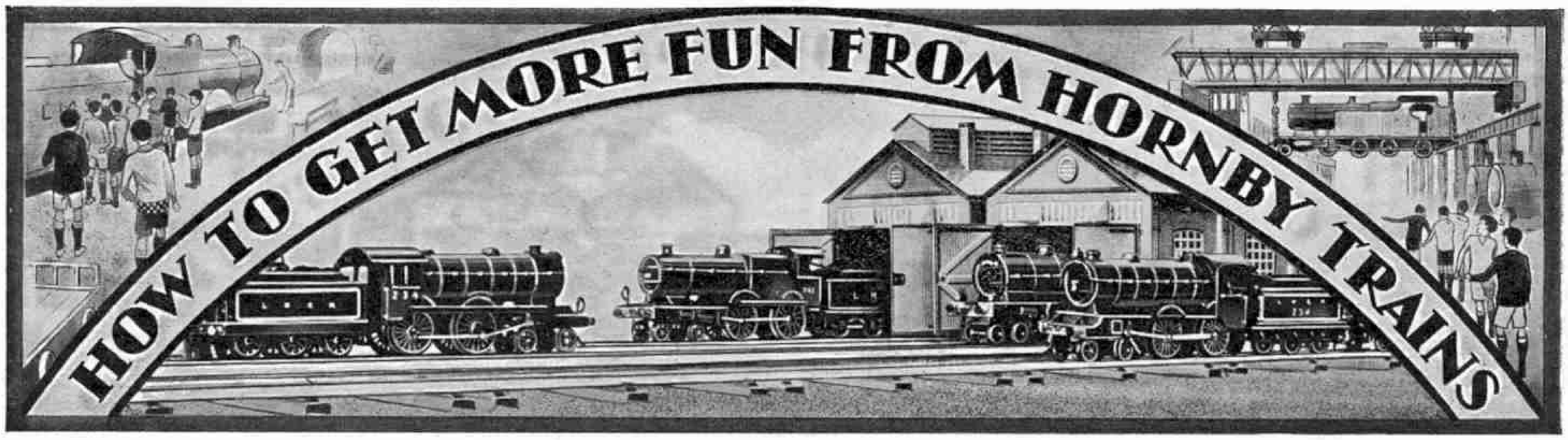
Proposed H.R.C. Branches

The following new Branches of the Hornby Railway Company are at present in process of formation and any boys who are interested and desirous of linking up with this unique organisation should communicate with the promoters whose names and addresses are given here. All owners of Hornby Trains or accessories are eligible for membership and the various secretaries will be pleased to extend a warm welcome to all who send in their applications:—

BOURNEMOUTH—Mr. B. Buxton, "Atherfield Cottage," Dean Park Road.
CANADA—N. Wilby, Vernon Prep. School, Coldstream, B.C.
DONCASTER—A. E. Draycott, Old Station House, Arksey.
EPSOM—Mr. C. J. Uncles, The Parade, The Broadway, Stoneleigh Park.
EWELL—E. K. Woods, 70, Gayfere Road, Stoneleigh Park.
LAHORE (INDIA)—Suraj Kumar-Dar, 9, Nisbet Road, Lahore.
LLANDUDNO—K. Jones, Lloyd's Bank House, Trinity Square.
LONDON—J. K. Burgess, 80, Bressey Grove, South Woodford, E.18.
LONDON—W. A. Hanson, 112, Essex Road, Leyton, E.10.

Incorporated Branches

255. PEVERIL—R. A. Owens, 18, Amherst Road, Fallowfield, Manchester.
256. BURTON MODEL RAILWAY BRANCH—R. E. Trotter, 2, Radmoor Road, Loughborough.

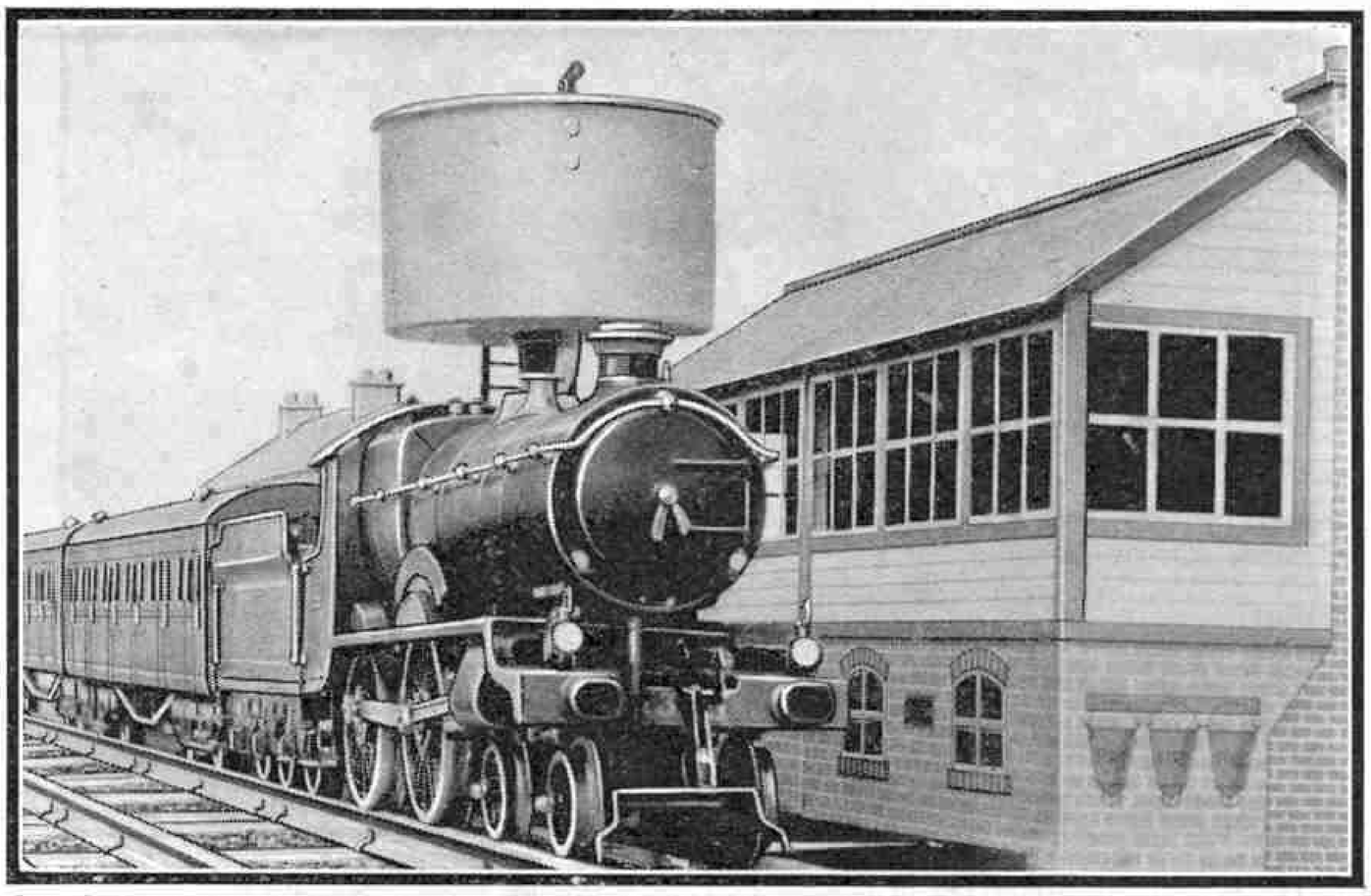


LXV.—REALISTIC TRAFFIC WORKING

IN miniature railway operation a feature that perhaps contributes more to the interest of the layout than any other is the correct and systematic working of trains and the performance of all the attendant duties in the correct manner. A certain definite scheme of operations should be adopted, as opposed to the mere haphazard running of different engines, coaches and wagons. Certain services should be arranged for the various kinds of traffic and the locomotives and rolling stock used should be in keeping, as far as possible, with the services decided upon. If operations are carried out with a definite purpose in view, the realism and interest of the line will be considerably increased. This applies not only to an elaborate layout with terminals and extensive marshalling yards, but also to a simple but well-designed railway.

The traffic passing over the line will vary according to the nature of the district which it is supposed to serve. For instance, an industrial area will have a service of heavy goods and mineral trains, and there will be their corresponding "returning empties." If the district is near the sea, shipyards may be found on the coast, and this will entail the carriage of heavy raw materials of all kinds. The loads of these trains will therefore be coal, which can easily be carried in miniature wagons, and iron, steel and miscellaneous engineering products, which may be represented in a very suitable manner by the use of "Meccano" parts. Shipbuilding productions such as model propellers and rudders may be loaded on to Trolley Wagons.

The passenger services in such an industrial and seaport area must also claim attention, and the general arrangement of these services will apply on almost any main line. There will be important expresses from other towns chiefly used by business people. This kind of train usually loads heavily, and dining accommodation is the rule, and may be assumed to be provided in the Saloon or Pullman Coaches included in the model express train. If there is considerable passenger traffic in and out of the port, then boat trains, both regular and special, will figure in the scheme of operation, and for these the Hornby Pullman stock will be quite suitable. The famous boat trains of the Southern Railway are good examples in actual practice. "*The Golden Arrow*" is normally an all-Pullman service, and Pullman specials are operated between Waterloo and Southampton Docks in connection with ocean liner traffic.



A typical express train on a Hornby layout. This is composed of Metropolitan Coaches and is hauled by the well-known No. 2 Special G.W.R. Locomotive "County of Bedford."

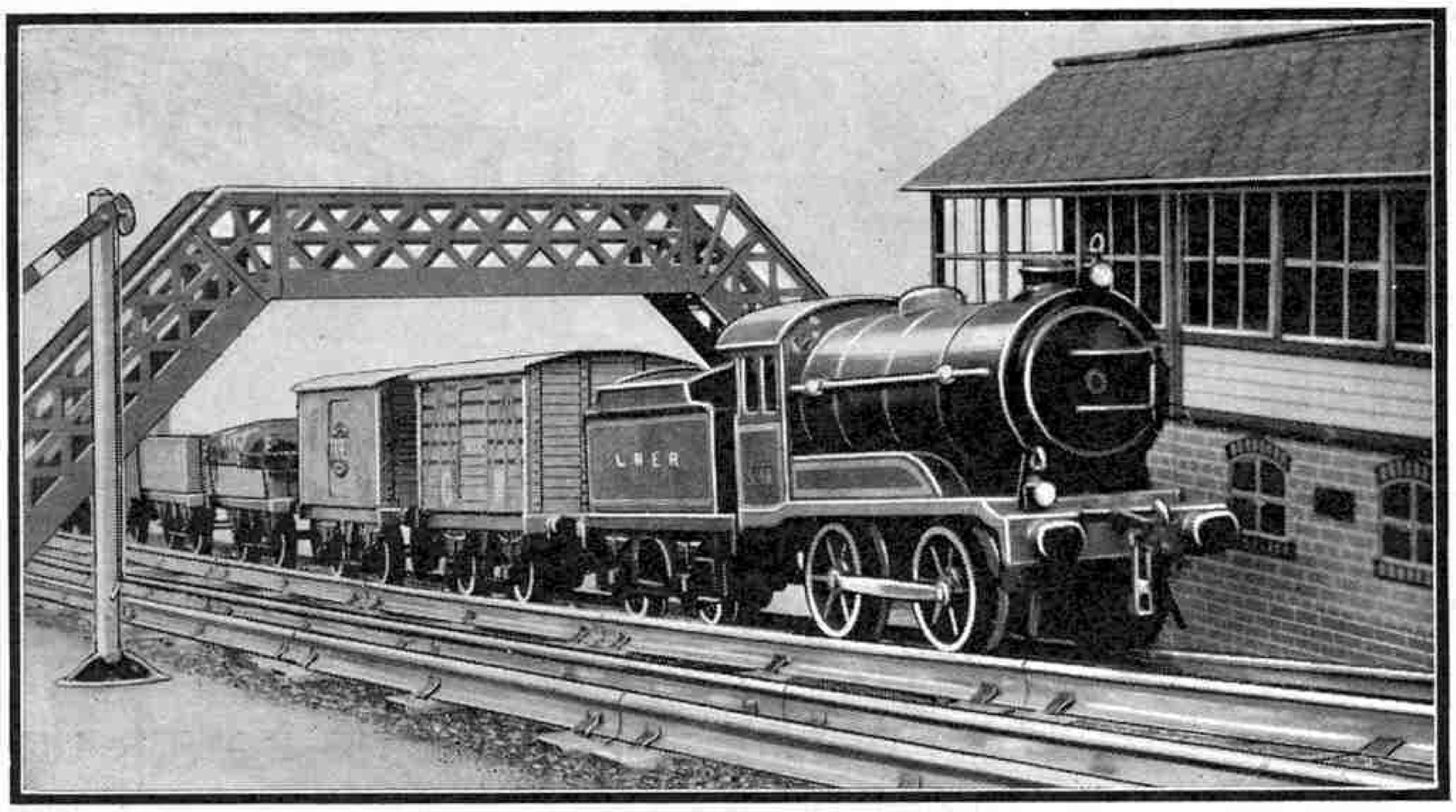
Purely local services will probably be very frequent and heavily loaded, more especially in the morning and evening. For "intensive" working of this kind tank locomotives such as the Hornby No. 1 and No. 1 Special Tanks and set trains of four-wheeled coaches will be most handy. The local services will then reproduce on a small scale, those that are worked in and out of Liverpool Street terminus on the L.N.E.R. This is the most frequent steam-operated service in the world, yet it is governed by ordinary signalling methods.

For the longer distance "residential" services, a large tank locomotive of the Hornby No. 2 Special 4–4–2 variety will be best, as these trains often run a fair distance on more or less express schedules. A feature of suburban working that should not be missed on a model railway is the running of the engines round their trains on arrival at the termini so that they are ready to work out again with the minimum of delay. It necessitates two crossovers or a loop line with two points, but the resultant convenience of not having the locomotive "trapped" in a terminal road makes it well worth while.

It is most fascinating to run the train in to a stop, and uncouple the locomotive, which then runs round its train and backs on the other end. When coupled up, either automatically or by hand according to circumstances, and re-wound, all is ready for the train to draw

out again. If the train is not to go out again for some time, the coaches may be taken to the sidings, and the locomotive will be free for another turn of duty, or it may proceed to the sheds if its day's work is finished.

A shunting yard should be provided where the redistribution of wagons is carried out. Large yards are found in real practice at Wath-upon-Dearne and at March on the L.N.E.R., Edgehill and Crewe on the L.M.S.R., and Banbury and Acton on the G.W.R., while the Southern has a fine yard at Feltham. While it may not be possible to lay out very extensive sidings on a model line, a simple yard, either of the "hump" type with "gridiron" sidings, or of the ordinary type, will give a good deal of scope for realistic marshalling operations, which form one of the most interesting features of model railway working. Even in a yard of three or four sidings the operations possible with a train of 10 wagons of various kinds are practically without limit, for the wagons may be arranged in any pre-determined order in the train. Then they may make a journey, and perhaps be "broken up" and rearranged in quite different groups of twos and threes or an entirely different order altogether. The same 10 wagons can of course be arranged in a great number of different ways.



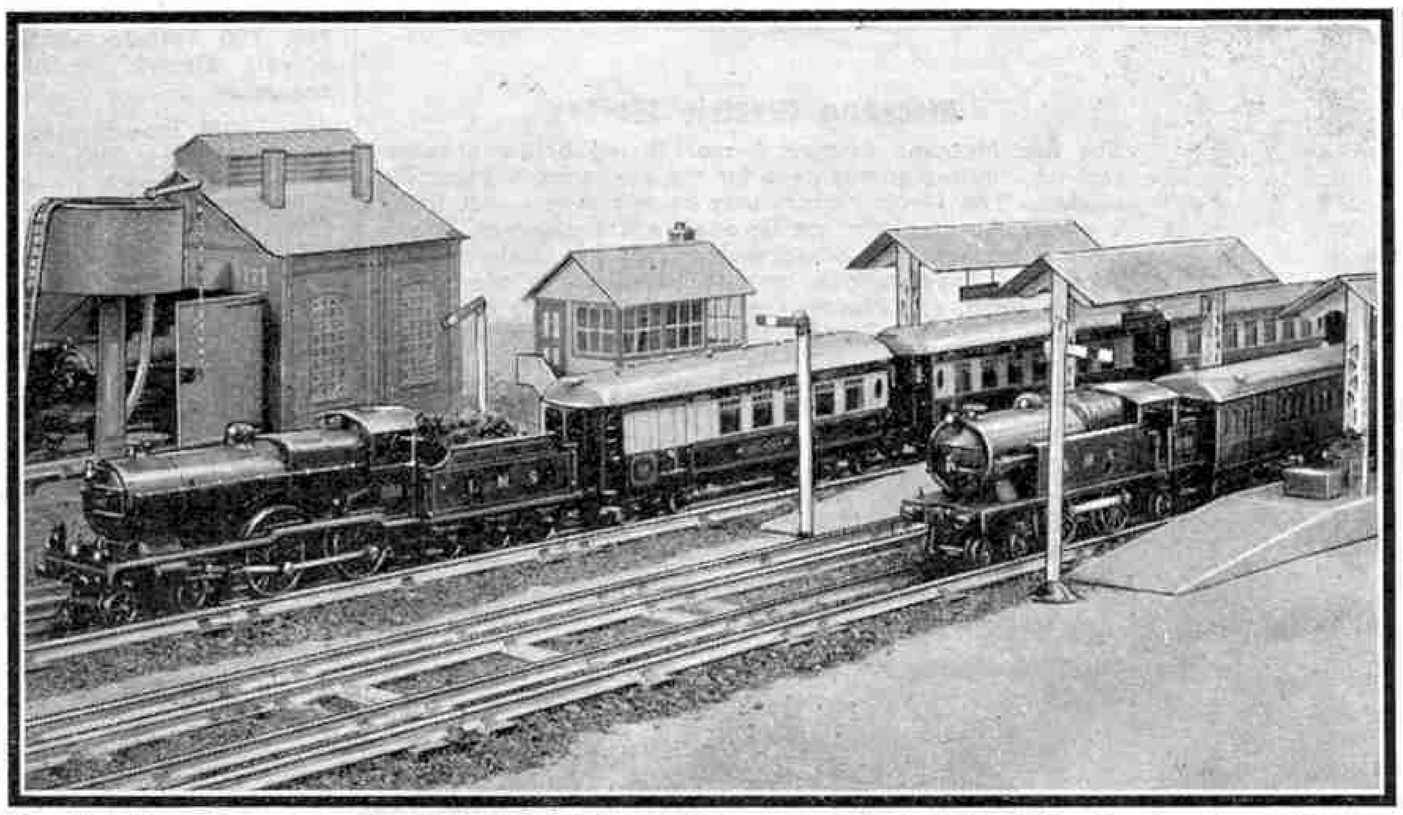
A Hornby No. 0 Locomotive at the head of a through mixed goods train. The variety of rolling stock available enables many types of trains to be made up in the correct manner.

In an agricultural district the chief goods traffic will be in the carriage of farm and dairy produce, livestock, and a certain amount of general merchandise. The ordinary array of goods wagons usually seen in typical country districts include open wagons that carry general goods, the same wagons being used also for carrying hay and other items in bales covered over with tarpaulin sheets. For this purpose the Hornby Open Wagon B with tarpaulin bar is very useful. A few covered vans, Milk Vans and Cattle Trucks should be provided, and Refrigerator Vans will be suitable in miniature for fruit traffic when in season.

For traffic coming to an agricultural district the use of open wagons for the local coal supply, and of covered vans for general merchandise, will tend to balance the working of these wagons in the other direction and thus minimise empty wagon mileage. Fruit and milk vans will arrive empty as a rule in ones and twos attached to passenger trains, or if traffic is heavy in complete trains. In this connection the uses of the Hornby Milk Tank Wagon in representing up-to-date practice should not be forgotten. Occasionally agricultural machinery will arrive, and such consignments may be reproduced in miniature by the use of the Farm Tractors of Modelled Miniatures Set No. 22.

The passenger service to a small country township will probably not be very frequent as regards express trains, but an important centre should be well served. If the station is on the main line, many expresses will pass over the line, but will not necessarily stop. There should therefore be a good service of local semi-fast and stopping trains.

Miniature railways that deal chiefly with passenger traffic do not offer such a wide scope of operations as is possible with those where goods working is specially studied. However, regular and also special passenger trains must be run, the latter appearing in large numbers at holiday times. A feature of trains of this kind nowadays is the provision of restaurant facilities, so that Pullman and Saloon Coaches may be employed in their composition on model railways.



An all-Pullman Special passing through a station, while a suburban train is waiting to start from the near platform. The disposition of the various accessories shows how easily realistic effects are to be obtained.

The type of service that it is desired to run will to some extent govern the general plan of the model system. With a permanent layout in a room set aside for the purpose there is practically no limit to the scope of operations, provided that the line has been well planned with a definite object in view. Quite an amount of interest and entertainment can be derived from a portable railway, however, laid down when required and taken up when necessary. If it is arranged on a suitable baseboard in sections it will not take long to lay out or take up again, so that this plan avoids the greatest disadvantage of the ordinary portable track, but the layout cannot be altered so easily.

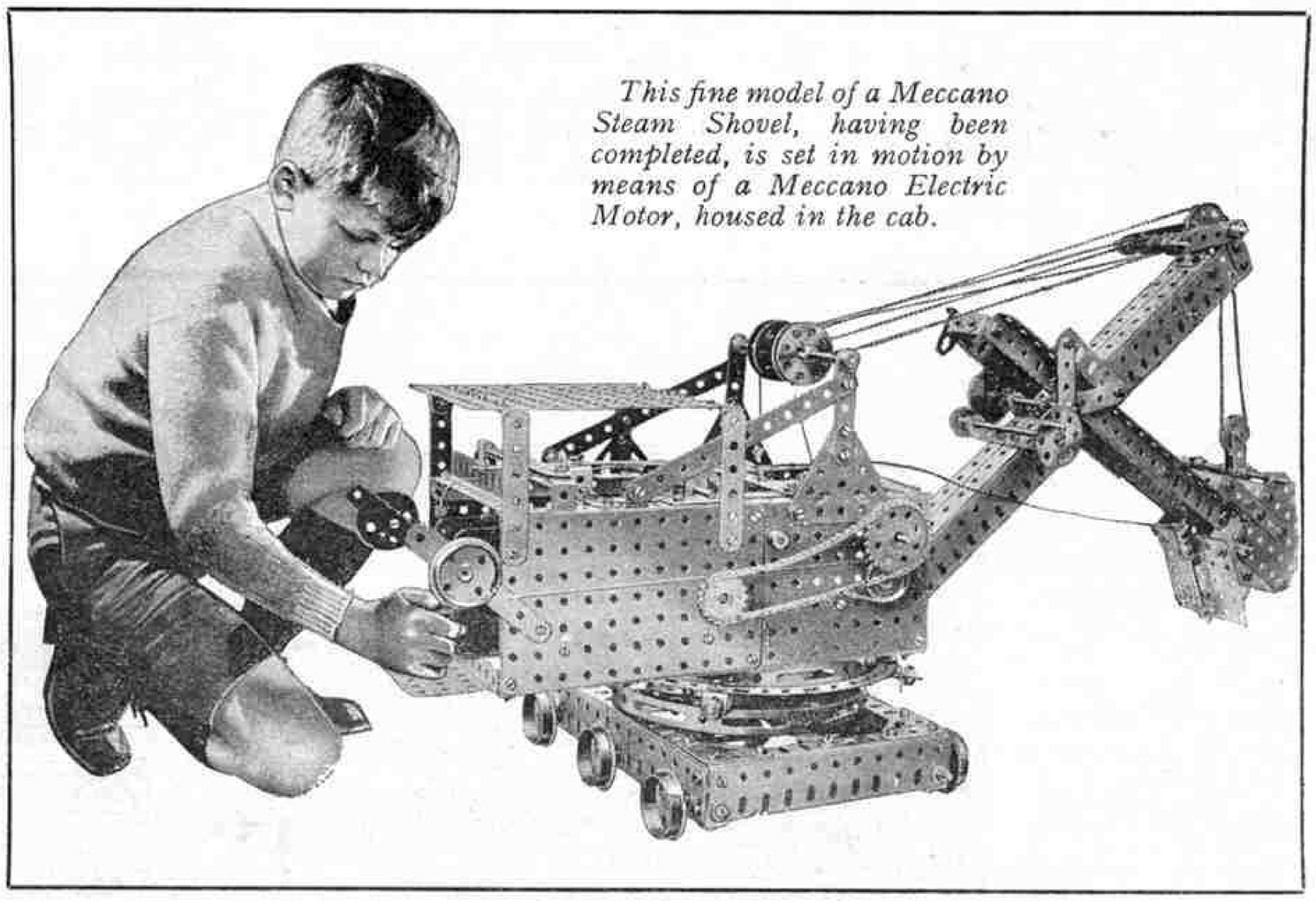
Use a Meccano Power Unit

Building a Meccano model is the greatest fun in the world. Excitement increases steadily as the model grows, part by part, under your hands. Finally there comes the greatest thrill of all. You connect your completed Crane, Motor Chassis or Traction Engine to a Meccano Motor and see it work in exactly the same manner as its prototype in real life!

The Meccano Motors are strongly made and the utmost care is taken in their manufacture to ensure that they will give satisfaction. Particulars and prices are given below.

MECCANO LIMITED

Binns Road **Liverpool 13**



This fine model of a Meccano Steam Shovel, having been completed, is set in motion by means of a Meccano Electric Motor, housed in the cab.

DETAILS OF MECCANO POWER UNITS

Meccano Clockwork Motors

These are the finest clockwork Motors obtainable for model driving. They have exceptional power and length of run and their gears are cut with such precision as to make them perfectly smooth and steady in operation.

X SERIES CLOCKWORK MOTOR. A fine Motor specially designed to drive with ease any of the X Series models. It is non-reversing ... ... Price 2/6

No. 1 CLOCKWORK MOTOR. An efficient and long-running Motor fitted with a brake lever. It is non-reversing ... ... Price 5/–

No. 1a CLOCKWORK MOTOR. This Motor is more powerful than the No. 1 Motor and is fitted with reversing motion. It has start, stop and reverse levers. Price 7/6

No. 2 CLOCKWORK MOTOR. This is a Motor of super quality. Brake and reverse levers enable the Motor to be started, stopped or reversed, as required. Price 10/–

Meccano Electric Motors

The five Meccano Electric Motors listed below provide smooth-running power units for the operation of Meccano models. The 6-volt Motors may be operated either from a 6-volt Accumulator or through a Transformer direct from the mains, providing that the supply is alternating current. They cannot be run satisfactorily from dry cells. The 20-volt Motors are most conveniently operated through a 20-volt Transformer from alternating current supply mains.

No. E1 Electric Motor (6-volt). Non-reversing	Price	9/–
No. E6 Electric Motor (6-volt). Reversing	,,	15/6
No. E1/20 Electric Motor (20-volt). Non-reversing	,,	10/–
No. E20A Electric Motor (20-volt). Non-reversing	,,	16/6
No. E20B Electric Motor (20-volt). Reversing		18/6

Meccano Transformers

A Meccano Transformer provides a convenient and safe means of driving a Meccano Electric Motor from the mains supply where this is alternating current.
There are six Transformers in the series, all of which are available for the following A.C. supplies :—100/110 volts, 50 cycles ; 200/225 volts, 50 cycles ; 225/250 volts, 50 cycles. Any of the Transformers can be specially wound for supplies other than these at a small extra charge. When ordering a Transformer the voltage and frequency of the supply must always be stated.

No. T6 Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors. Fitted with speed regulator. Price 21/–

No. T6M Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors. This is similar to No. T6, but is not fitted with a speed regulator ... ... Price 16/6

No. T6A Transformer (Output 40 VA at 9/3½ volts) for 6-volt Electric Motors. Fitted with speed regulator and separate circuit for supplying current for eighteen 3½-volt lamps ... ... Price 26/6

No. T20 Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors. Fitted with 5-stud speed regulator ... ... Price 21/–

No. T20M Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors. This is similar to No. T20, but is not fitted with speed regulator ... ... Price 16/6

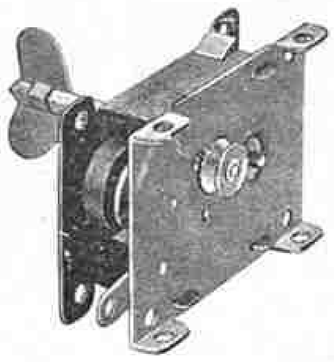
No. T20A Transformer (Output 35 VA at 20/3½ volts) for 20-volt Electric Motors. Fitted with speed regulator and output sockets for lighting lamps ... Price 26/6

Accumulators

The 6-volt 20-amp. Accumulator is specially suitable for running Meccano 6-volt Motors and Hornby 6-volt Electric Trains ... ... Price 27/9
The 2-volt 20 amp. Meccano Accumulator is supplied for converting 4-volt Accumulators to 6-volt... Price 9/3

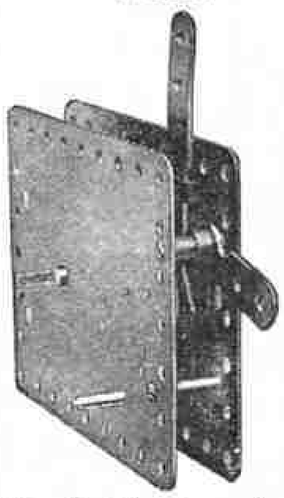
Resistance Controller

By use of this Controller the speed of Meccano 6-volt Motors and Hornby 6-volt Electric Trains may be regulated as desired ... ... Price 3/9

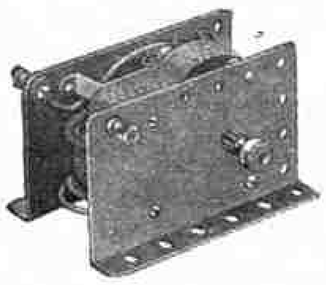


X Series Clockwork Motor

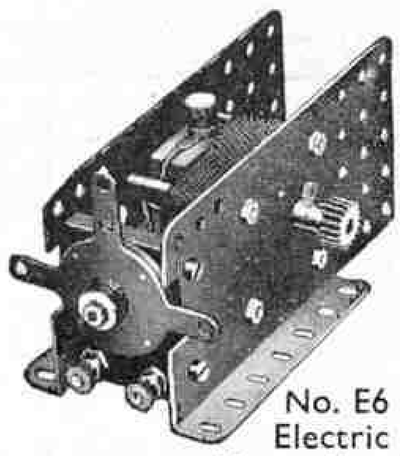
No. 1 Clockwork Motor



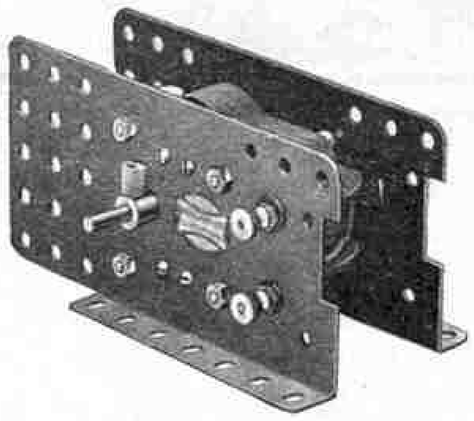
No. 2 Clockwork Motor



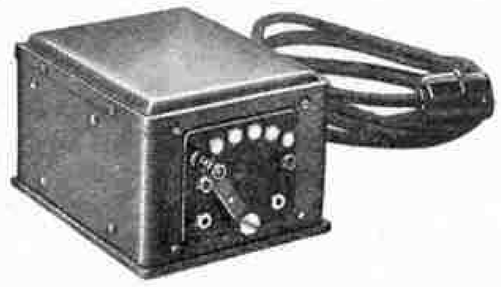
No. E1 Electric Motor (6-volt)



No. E6 Electric Motor (6-volt)



No. E20a Electric Motor (20-volt)

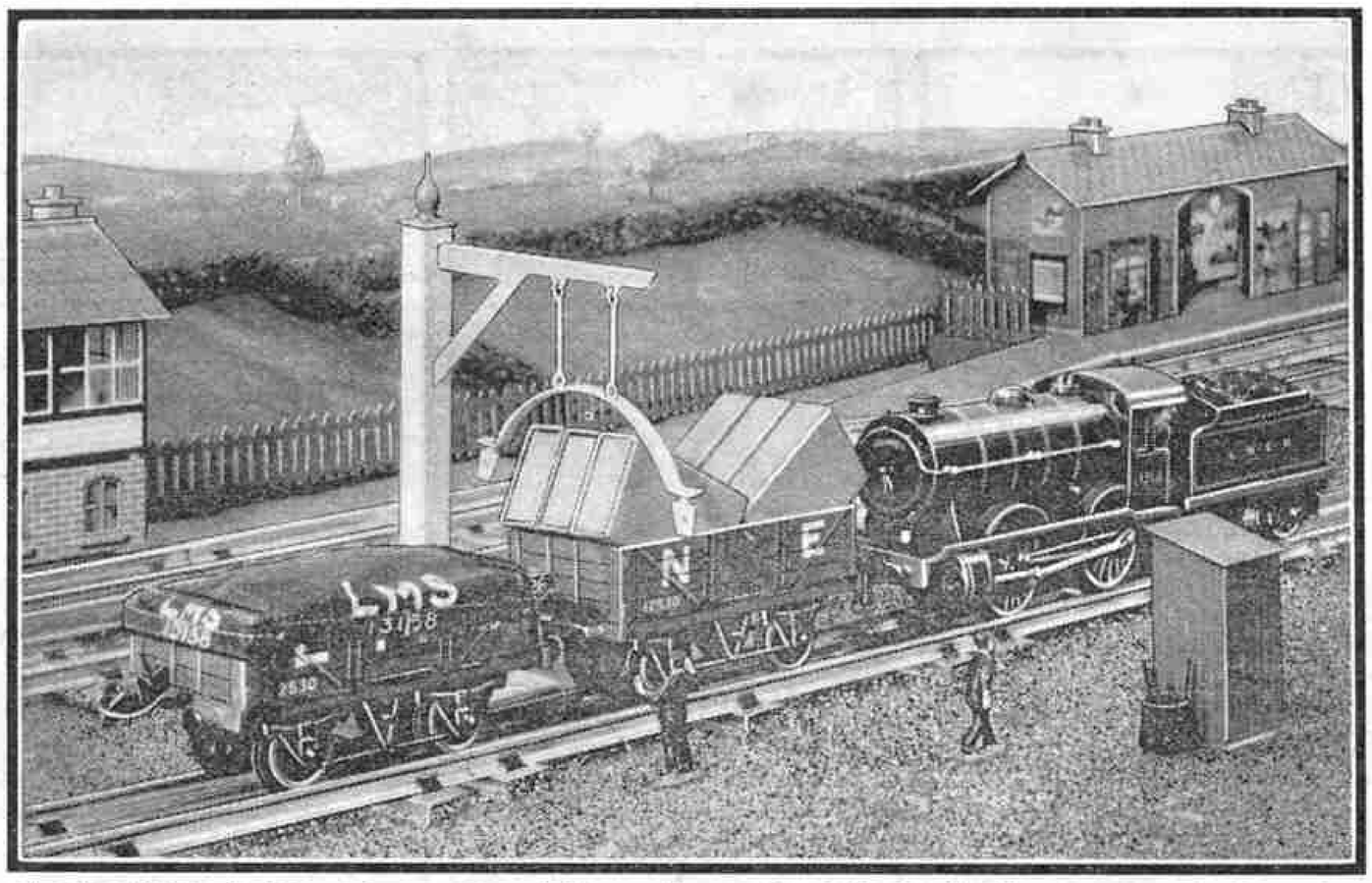


No. T20 Transformer

Loading Gauges Real and Model

Their Construction and Use

OF the many appliances that interest the budding enthusiast when he begins to examine a railway with a more critical eye, a familiar example is the loading gauge. Even a country district goods yard is necessarily provided with one, for its function is important, and in a big yard there are invariably several distributed on different roads. In general construction the ordinary loading gauge resembles an old-time gallows with its main post, projecting cross-piece, and support. From the cross-piece is suspended the gauge bar that indicates the loading limit. On some gauges, such as that illustrated on this page, a small bell is mounted on the gauge bar, so that if the bar is struck as a truck passes beneath it an audible warning of the excessive bulkiness of the load is given, and measures are then taken to reduce this so that it comes within the limits set by the gauge. The main post is placed so that the gauge bar is suspended centrally over the track to which it applies. Sometimes, where there are several parallel tracks, a gantry type of structure is erected spanning them, and the necessary gauge bars are suspended from the beam of the gantry.

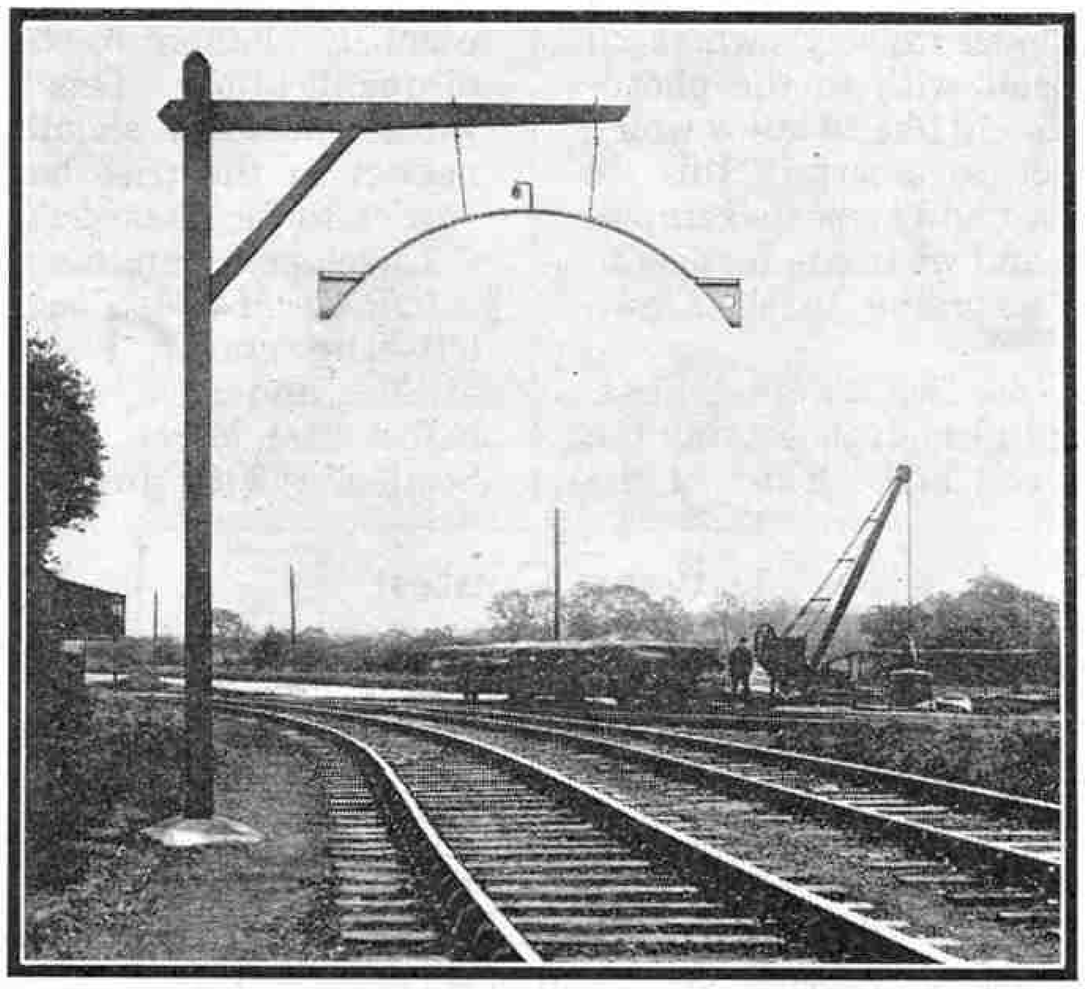


The Hornby Loading Gauge in use on a miniature railway. The bulky load in the wagon next to the engine is being tried under the gauge in order to see that it is safe for travelling.

Although the usual loading gauge post is constructed of wood, only the fittings being of metal, the G.W.R., whose practice is original in so many respects, make use also of an all-metal type of gauge. In this the post is formed of two rails together, set in a bed of concrete, and the cross piece or projecting bar is tubular in section.

An interesting feature of the gauge illustrated on this page is seen in the ends of the gauge bar, which are hinged to the main portion of the bar and are formed of flexible material. The object of this is to minimise the risk of injury to a locomotive driver who, in passing under the gauge, might lean out of the cab in order to catch the shunter's signals, and thus strike the gauge bar with his head.

The miniature loading gauge is naturally an important item on a Hornby layout, and of the two patterns available in the Series, the standard Loading Gauge follows closely the general lines of the actual one illustrated, as a comparison of the photographs shows. In accordance with the usual Hornby practice, it has a stout post secured to a substantial base, and the post is capped by a spiked finial. From the post projects the cross-piece and from this is suspended the gauge bar, the separate ends of which are specially shaped and are hinged to the main bar as in the real gauge. This is an interesting detail that makes the Hornby Loading Gauge distinctive, and its realistic appearance adds considerably to the effect of a miniature goods yard.



A typical loading gauge in a country goods yard. The gauge bar is provided with special hinged ends and with a small bell as described in this article. Photo by courtesy of the L.M.S.R.

The "M" Series Loading Gauge is less elaborate, but at the same time is an effective accessory. The post, cross-piece and support are formed in one piece, and the top of the post is shaped to represent a metal cap or flat type of finial. The post is mounted in a neat die-cast base that ensures that the post will stand up firmly and not be affected by the vibration of passing trains. The gauge bar and its shaped end pieces are also made in one piece, and are neatly attached to the cross-piece.

The position of a Loading Gauge on a miniature system is a point that is seldom given the attention it deserves. It is sometimes necessary to compromise between the most effective and the most railway-like site for the gauge, but obviously this should never be placed over a road normally used for running. The purpose of the gauge must be borne in mind, and the convenience of the staff who are supposed to make use of it should be studied as far as possible. Where a yard includes a Goods Platform, the loading gauge may be placed fairly near this, as the crane mounted on the Platform will be responsible for the loading of the bulky consignments that are the most likely to infringe the limits set by the gauge.

Even in a small yard with only one siding, and possibly no goods loading platform or bank, a gauge looks quite well, and relieves the deserted appearance that a simple yard often presents. In a large yard, with a number of roads devoted to loading traffic, the provision of several gauges will be necessary in order to ensure that the equipment of the line is complete.

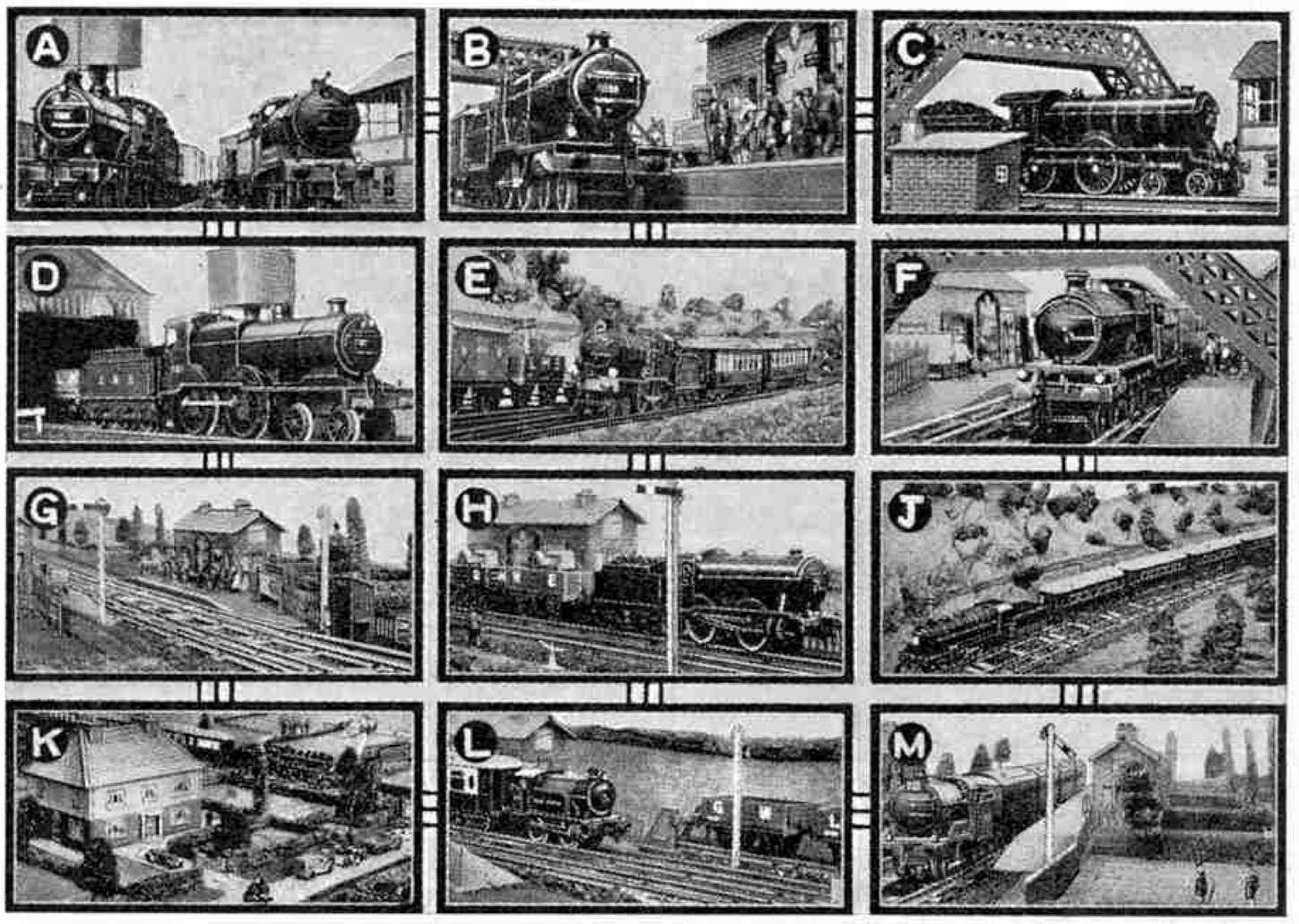
Where a covered goods shed is used in actual practice a loading gauge bar is frequently suspended from a beam within the building for loads made up inside. The necessity for a similar provision hardly arises on a miniature railway but for the sake of completeness those who have covered goods sheds on their railways may fit a gauge bar at the entrance to the shed. The bar may be taken from a Loading Gauge the post of which has become damaged; or may be simply formed from a piece of wire suspended by thread, or fine chain if this is available.

H.R.C. COMPETITION PAGE

Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries should have the title of the competition clearly written in the top left-hand corner and should be addressed to the Hornby Railway Company, Meccano Ltd., Binns Road, Liverpool 13. The name, address and membership number of each competitor should appear in clear writing on the back of every sheet of paper used.

MODEL RAILWAY PHOTOGRAPH VOTING CONTEST

During the past few years there have appeared in the H.R.C. pages of the "*M.M.*" large numbers of photographs illustrating various points of model railway practice, and showing how the greatest possible interest and enjoyment can be obtained from a Hornby railway. These photographs have attracted widespread attention on account of their remarkable realism, not only in the actual railway arrangements photographed, but also in the various scenic effects that are obtained. The introduction of Countryside Sections some time ago has greatly increased the possibilities of scenic realism, and consequently the photographs have reached a further stage of interest.



Our correspondence shows that these illustrations have been of the greatest value to model railway owners all over the world. The subjects dealt with in the photographs are very varied, and we should like to know which are the most popular. In order to ascertain this we reproduce this month twelve recent and typical examples of Hornby railway photographs, and we invite readers to place these in order of merit according to their own personal views.

Competitors are required to do two things. First, they must decide upon the order in which they think the photographs should be placed, and make a list of the letters representing them accordingly. Second, they must state their reasons for selecting the particular photograph that they have placed first in the list. There is no need for this to be stated at great length ; a few words will suffice.

Prizes of Hornby railway material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the four competitors in each section, Home and Overseas, whose lists most accurately forecast the total vote of all the competitors. In the event of a tie for any of the prizes, preference will be given to the neatest and most novel entry. In addition there will be a number of consolation prizes.

Every entry submitted for this contest must be clearly marked with the sender's name and full address and H.R.C. membership number. Failure to observe this condition will result in disqualification. This is an important feature to which members should pay special attention, as its neglect in the past has occasionally caused promising entries to be discarded.

Envelopes containing entries must be clearly marked "*H.R.C. March Photo Voting Contest*" in the top left-hand corner, and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 31st March. The closing date for the Overseas Section is 30th June.

Drawing Contest

Our Drawing Contest series, the first of which was announced in January, is proving very popular. We have pleasure, therefore, in announcing another similar Contest this month. The subject we have chosen is "*A Driver Oiling His Engine.*" This is a sight with which every H.R.C. member must be familiar.

To the senders of the four best entries in each section, Home and Overseas, prizes consisting of Hornby Train (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded.

Envelopes containing entries must be marked "*H.R.C. March Drawing Contest*" and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 31st March. The closing date for the Overseas Section is 30th June.

Essay Contest

In America the majority of locomotives are fed with coal by means of a mechanical stoker ; in Great Britain there is no example of a mechanical stoker, all the coal being fed into the fire-box by hand. This month we invite H.R.C. members to send us an essay not exceeding 500 words in length on "*Why The Mechanical Stoker Is Not Used On British Locomotives.*"

Prizes of Hornby Train (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders of the best entries in each section, Home and Overseas.

Envelopes containing entries must be marked "*H.R.C. March Essay Contest,*" and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, by 31st March. Overseas closing date 30th June.

COMPETITION RESULTS

HOME

December "Loco Errors Contest." 1. C. D. Eagling (31292), Mortlake ; 2. J. C. Button (10335), Crewe 3. E. B. Simpson (36342), Spondon ; 4. K. Costain (5108), Bolton. Consolation Prizes : S. Howarth (21914), Oldham ; A. H. Watson (32054), Budleigh Salterton ; R. Barbary (5580), Mevagissey ; J. P. Cunliffe (4534), Burton-on-Trent ; A. McLeish (30567), Perth ; J. Mathewson (34686), Scotstoun ; H. Taylor, Flixton ; D. Fear (18477), Taunton.

December "Railway Drawing Contest." 1. C. A. Brunt (10229), Leeds 3 ; 2. L. Martin (6922), Leicester ; 3. F. A. Lawley (27087), Cradley ; 4. R. Tredwell (36031), Wolverhampton. Consolation Prizes : G. T. Porter (10259), New Barnet ; W. Fountain (14430), Dewsbury ; C. E. T. Harris (27133), Mill Hill, London, N.W.7.

OVERSEAS

August "Railway Joke Contest." 1. E. C. Heath (29104), W. Pennant Hills, Australia ; 2. A. McIntyre (30925), Winnipeg ; 3. W. H. Jack (8958), Ballarat East, Australia ; 4. L. W. Best (30016), Christchurch, New Zealand.

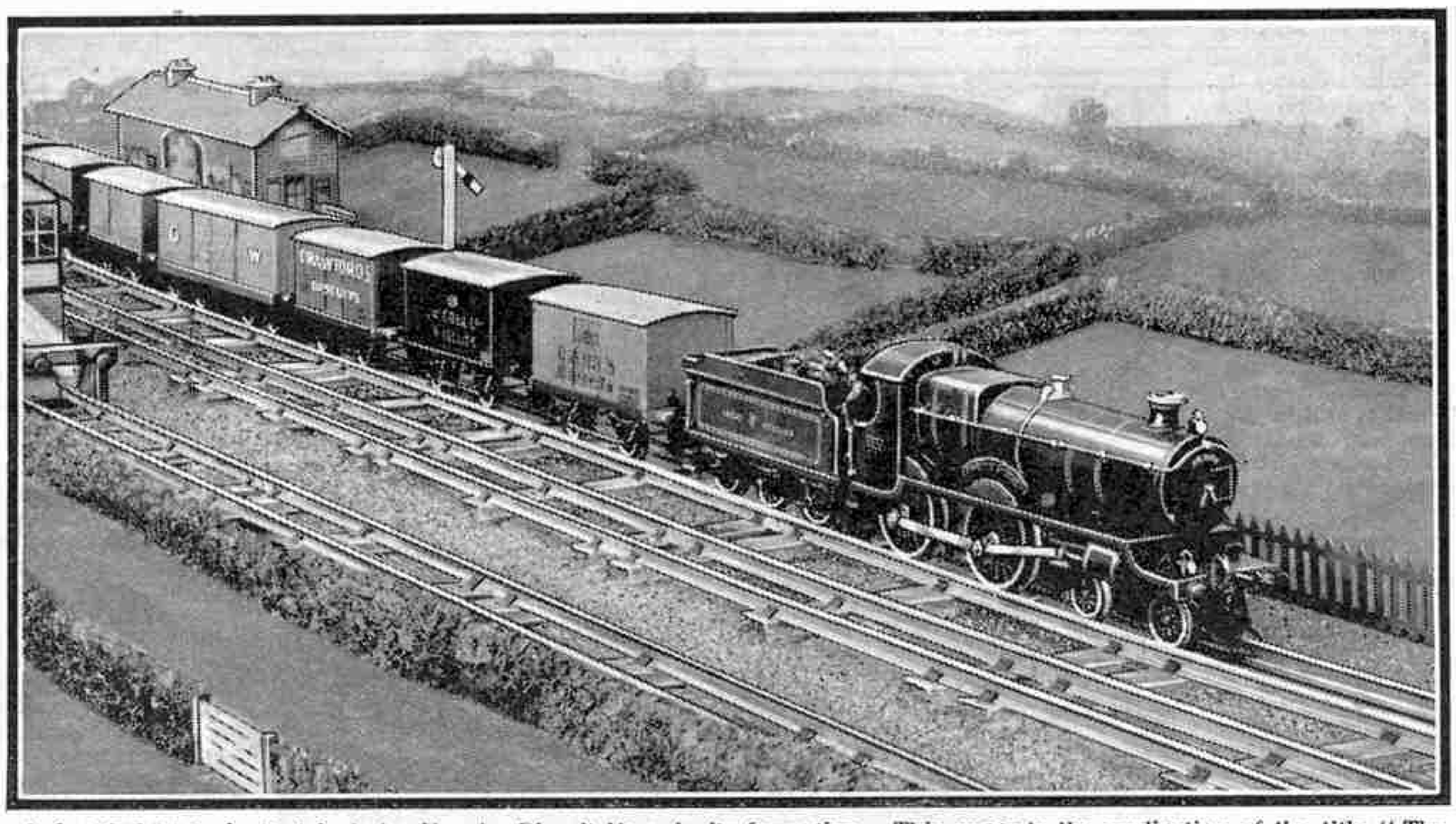
September "Missing Words Contest." 1. G. E. Schulz (15425), Coromby, Australia ; 2. D. J. White (9333), Dunedin, N.Z. ; 3. G. V. Wilkinson (23731), Durban, S.A. 4. W. S. Eagle (31779), Bombay.

Fast Freight Trains in Miniature

Hints on Their Formation and Running

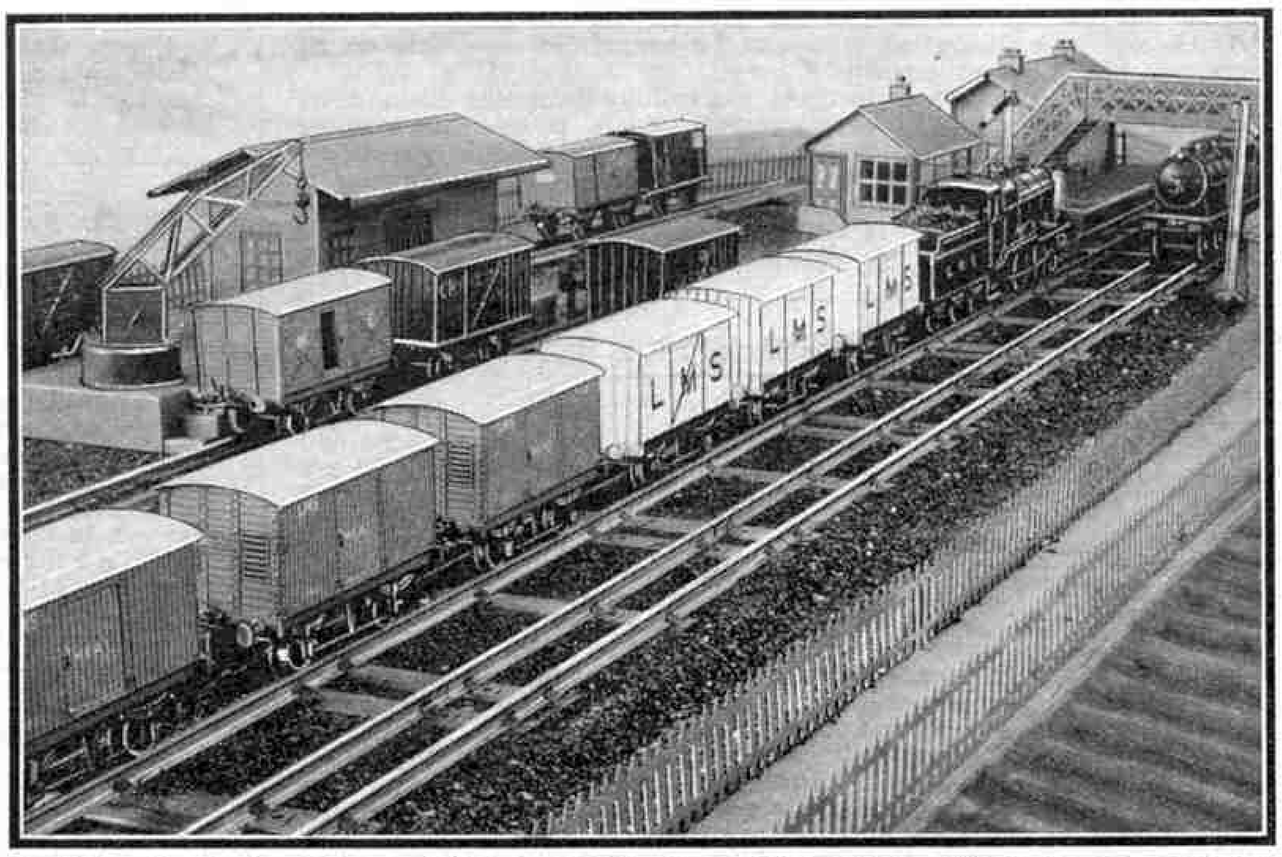
A FEATURE of modern railway operation is the running of large numbers of express goods or fast freight trains. These run between ports, manufacturing towns and distribution centres, and enable the rapid service to be given that is demanded to-day by trader and public alike.

Various well-known examples of these trains have been mentioned in the "*M.M.*" from time to time, such as the 3.40 p.m. "Glasgow Goods" of the L.N.E.R., and the 7.45 p.m. from Camden to Edge Hill of the L.M.S.R. The L.N.E.R. train is the fastest of British goods trains, and covers the 436 miles from King's Cross to Glasgow at an average speed of 32.5 m.p.h., making six stops on the way. Over its longest non-stop stretch of 111.7 miles from Peterborough North to Severus Junction at York its average speed is as high as 43.8 m.p.h. The L.M.S.R. train makes an average of 39 m.p.h. over its 191-mile non-stop journey, a longer non-stop run than is made by any other British goods train.



A fast freight train that includes Hornby Biscuit Vans in its formation. This suggests the application of the title "The Biscuit" that is used to indicate one of the many G.W.R. named freight trains of real practice.

Particular interest is attached to the working of fast freight trains, as special regulations are framed for their working in order to ensure that their journeys are completed in safety and according to schedule. Thus the L.M.S.R. train just mentioned is composed exclusively of stock fitted with the vacuum brake, so that its operation approximates to that of a passenger train. In order to eliminate the possibility of delay through over-loading, its make-up is restricted to 45 vehicles. Other fast freight trains are similarly restricted as to their composition, and in the case of those not made up of brake-fitted vehicles, the proportion of braked and unbraked stock is definitely laid down.



An interesting train made up of Hornby Refrigerator and Meat Vans. These Vans are suitable for several varieties of trains for perishable traffic in miniature.

On a Hornby Railway the operation of trains representing the fast freights of actual practice can form an extremely interesting part of the running programme. There is a large selection of suitable rolling stock in the Series, particularly of the covered vans of which fast freight trains are chiefly composed. For the trains of perishables, which naturally are required at their destination at the earliest possible moment, there are Refrigerator and Meat Vans, Fish and Banana Vans, Tank Wagons and Vans for milk traffic, a Cadbury's Chocolate Van, and Biscuit Vans representing three different well-known firms. In the upper illustration on this page these Biscuit Vans are shown as part of a fast freight train hauled by a G.W.R. No. 2 Special Locomotive, and this reminds us of the characteristic G.W.R. practice of allotting names to many of their freight trains. The miniature example shown might well be termed "*The Biscuit*," a name allotted in actual practice to the 10-30 p.m. from Reading, a town famous for its biscuits, to Laira.

Several other names of this nature are current among the G.W.R. staff, and it is interesting to find that these have been used for many years by the men associated with the particular trains, and have not been applied merely as a matter of advertising policy. "*The Meat*" is another example that could be represented very well with Hornby components. This title refers to the 3.55 p.m. from Birkenhead to Smithfield, and the name and destination of the train indicate the type of vehicles that are used in its make-up. A train of Meat and Refrigerator Vans, though hauled by an L.M.S.R. engine in this case, appears in the lower illustration.

Apart from the special-purpose vans already mentioned, other items of Hornby Rolling Stock that can be used for such trains include the Luggage Vans and Cattle Trucks of both No. 1 and No. 2 patterns. Then there are the Open Wagon "B" and the Open Wagon No. O and No. 1 that can be used quite correctly in a fast freight train. These vehicles and the Luggage vans are of course suitable for general goods, and would not be used as a rule in assembling a perishable train. Such names as "*The General*," "*The Hardware*," and "*The Tinman*," applied to various G.W.R. fast freight trains, certainly do not suggest that perishables are carried by them! Thus there is plenty of scope for the use of the more ordinary items of Hornby Rolling Stock in arranging the express good services of a miniature railway system.

As regards motive power, passenger locomotives are now frequently used on fast freight duties. In miniature the No. 3 and No. 2 Special Locomotives of the Hornby Series therefore can quite well be employed on such trains. The No. 1 Special Locomotives are essentially fitted for this type of work, and in their general handiness they resemble real mixed traffic locomotives.

Rochester's Famous Bridges—(*C. from p. 201*)

by the Royal Marine Band and the Wardens and their assistants passed over the old bridge and along the river bank to the new bridge, at the approach to which a great crowd had assembled. On arriving at the centre of the new bridge the procession stopped, and the Earl of Romney, addressing the Mayor, declared the bridge open to the public. The Mayor expressed the thanks of the Corporation and citizens for the privilege granted. In the evening a great display of fireworks took place on the old bridge, and the celebrations terminated with a banquet at the Corn Market.

When the new bridge was put into service the old one was demolished, and the removal of its unpopular starlings freed the river from all obstruction at that point. It is of interest to note that it never became necessary to open the swing bridge for the passage of ships, and in 1890 Parliament consented to its being permanently closed to river traffic.

The size of the ships using the river continued to increase, and as early as 1896 some of the iron arches of the bridge were damaged by lighters colliding with them owing to lack of headway. In 1906 and 1907 the arches were damaged again by lighters, and eventually the Wardens sought the advice of the bridge engineers, who recommended that the iron arches should be replaced by straight steel girders so as to give increased headway. The Wardens accepted their advice and the work was carried out at a cost of about £100,000. One half of the work was completed before the other half was commenced, so that there was no complete stoppage of road traffic over the bridge. The reconstructed bridge was formally opened on 14th May, 1914, and is still in use.

In this article we have confined ourselves to the road bridges at Rochester, but in addition there is a railway bridge that carries the lines of the Southern Railway.

Radium from Canada

Canada has now become an important producer of radium. The deposits from which supplies of the precious metal are obtained were discovered four years ago at Great Bear Lake, in the Northwest Territories, and after a long period of research and preparation a steady output is being maintained from a refinery established at Port Hope, Ontario. So far several grams of radium have been produced, and it is expected that the supply will be increased until it is sufficient to provide for the needs of the Empire.

Canada's radium mines are in the far north and are difficult of access, particularly in the winter months, but the transport troubles are being overcome by the use of aeroplanes, in which the radium ore is carried to the nearest railway station. Experiments are now being conducted with a view to carrying out some of the refining processes on the spot in order to reduce the amount of material that has to be transported to the refinery in Ontario.

The world's supply of radium at present is not very large. From the time of the discovery of the element until 1931, the total quantity extracted was only 555 grs., or about 1¼ lb. Production during 1931 and 1932 proceeded at the rate of 35 grs. or 1¼ oz. a year, and it is expected that eventually the rate will be greatly increased by working the Canadian deposits on a more extensive scale. This is welcome news, for radium has proved its worth in the treatment of that dreaded disease cancer. Its price has been reduced considerably in recent years and any further fall due to increased production will help to extend its use.

New L.M.S.R. 2-6-0 Locos—(*Cont. from p. 213*)

The engines are arranged to be driven on the left-hand side, and all the cab controls are arranged for convenient handling. A steam manifold with a main shut-off valve is provided on the top of the fire-box doorplate in the cab, on which are the necessary valves for the ejector and steam brake, the injectors, the pressure gauge, the whistle, and for carriage-warming purposes.

The steam brake is fitted to the coupled wheels of the engine and on all six tender wheels, and is controlled by the driver's vacuum brake valve. When the engine is standing the ejector maintains the vacuum on the engine and train, but a vacuum pump driven from the crosshead on the left-hand side is provided for this purpose when the engine is running. For boiler feed purposes an exhaust steam injector is fitted on the fireman's side, and on the other side of the engine a live steam injector is provided. The boiler mountings in general, such as the water gauge frames and protectors, are of the standard pattern adopted by the L.M.S.R.

Steam sanding is provided, the sand delivery pipes being placed in front of the leading coupled wheels, and both at the front and the back of the driving wheels.

The tender is of standard type with a capacity for 3,500 gallons of water, and 5 tons of coal, and is equipped with water pick-up apparatus.

Electricity in the Home—(*Cont. from page 223*)

readily be carried out with the machine, for the roller can be held stationary in order to enable pleating and pressing to be carried out.

The manufacture of "BTH" electric washing machines follows similar principles to those already dealt with in the refrigerator and other domestic products, and the greatest care is taken to ensure ease of control and efficient action. For instance, the inner surface of the tub has no corners or sharp edges, and is highly polished in order to prevent the slightest risk of damage to clothes undergoing washing. Its outer surface is given a coating of a lacquer that is a poor conductor of heat, and thus helps to maintain the temperature of the water in the tub. The electrical mechanism is given a bench test run of at least six hours before it passes on to the washing machine assembly line, and the machine itself is thoroughly tested in actual working conditions, with the bowl filled with water. The test run is completed in a sound-proof cabinet, where the slightest operating noise can be heard and its source traced and corrected.

After emerging successfully from the many tests to which it is put, the machine is given its finishing coats of grey cellulose enamel and finally polished up for despatch. Even then a final inspection is made, and it is interesting to find that each machine in turn is suspended from a light overhead crane in order to allow every detail to be closely examined.

Schoolboy trying on a diver's helmet. Perhaps he is a future "ace" of the sea-depths!

Story of Artificial Silk—(*Cont. from page 195*)

about 90 lb. per sq. in.

All such figures relating to the heat, pressure and boiling time are at best only approximate, and are subject to variation, as all these factors are regulated by successive tests applied to samples of the contents withdrawn at intervals.

The liquor is withdrawn after a sufficient period of boiling and digestion, and when the pulp has been well washed it is emptied out into tanks or blow pits, where it is again washed and strained. The straining is done by sucking the pulp through fine slots in order to separate from it pieces of undigested chips, knots and foreign matter generally.

The wood cellulose is now ready for bleaching, and this is carried out by an electrolytic process. After washing, the pulp is spread so as to form a sheet of material, and is carried forward on an endless wire apron through which the water can drain. The material is then passed through a series of rotary presses, the first pair being covered with felt so as to form it into a sheet. Immediately following this stage steam-heated cylinders compress and dry it, and when the material has at last the appearance of a bleached board it is guided to automatic machines that cut it into rectangular sheets of a certain size. The sheets are packed into bales under hydraulic pressure, and are then ready for delivery to the rayon makers. The lower illustration on page 194 shows bleached wood cellulose cut into sheets in passing through the machine. In the next article in this series I shall describe how this material is transformed into rayon thread.

Deep-Sea Diving

Diving has been practised from very early times, particularly in the East. For something like 3,000 years natives of Ceylon have been accustomed to dive to considerable depths to bring up pearls, and corals and sponges have been brought up from the Indian seas. Many stories have come down to us of the skill of the early divers and of their ability to remain under water for considerable periods; but it is now known that without some appliance to maintain respiration the most skilful diver cannot remain under water for more than three minutes. The native diver's equipment consists simply of a lifeline, a heavy stone to enable him to sink, and a net in which to bring up his catch of pearl oysters.

At a later period diving became associated with the raising of treasure from sunken vessels, and the perilous nature of this work led to the endeavour to devise contrivances that would enable a diver to remain submerged with safety for longer periods and to descend to much greater depths.

A set of modern diving apparatus includes a helmet, a waterproof diving dress, a pair of weighted boots, and two lead weights that are carried on the breast and back of the diver. Other essential parts of the equipment are a lifeline and air pump, and a length of flexible air tube with metallic couplings. There are several types of diving helmets in use to-day, but the principles of construction and operation are the same in each case, the helmets differing only in mechanical details.

The deeper a diver descends the greater is the pressure of the water all around him, and in spite of his weight, due to his heavy suit, he soon reaches a depth at which he becomes lighter than the water he displaces. If his diving suit were not supplemented by some additional weight he would merely float about at the level at which his weight corresponded with that of the water. In order to enable him to sink easily to a considerable depth he carries heavy lead weights, shaped to fit close to his body. To enable him to stand firmly at the sea bottom he wears heavy boots, to the wooden soles of which are riveted lead soles.

Diving operations are usually carried out from a strong broad-beamed boat, large enough to accommodate the diver and the men who attend him, together with the pumps and other equipment.

The greatest depth at which divers have done practical work in safety is 300 ft., which was attained by divers of the British Navy in 1930. The periods spent under water varied from 10 to as much as 25 minutes.

The tasks that a diver is called upon to carry out are very varied and include the salvage of treasure from sunken vessels, the examination of under-water tunnels, and foundations of bridges, and the cleaning of ships' hulls below the water-line. When a ship has been in the water for a considerable period, marine growths and barnacles accumulate on the bottom in such quantities as to cause an appreciable decrease in speed, and from time to time divers remove this accumulation by means of special tools. This method of cleaning is much cheaper and quicker than dry-docking the ship.

A Glasgow Scout Show

A Scout Show organised by the Glasgow County Scout Council of the Boy Scouts Association is to be opened in the Kelvin Hall, Glasgow, on 13th April by H.R.H. the Prince of Wales. This event has been arranged to show what Scouting stands for, and a special feature is being made of the Arts and Handcrafts Section, in connection with which an interesting series of competitions is being held. One class in this series is devoted to Meccano Models, and in addition there are many classes for models that can be constructed wholly or partly of Meccano Parts. All the entries in these and other classes will be on view at the Show. Boys who are interested in hobbies and in Scout activities, should visit the Show, which will remain open until 20th April.

A Canadian Model-Building Competition

A Model-building Competition of great interest to Meccano enthusiasts living in or near Victoria, British Columbia, has been arranged by Messrs. Barber and Holdcroft, Barber's Toy Store, 1623, Douglas Street. It is the fourth annual contest organised by this enterprising firm, and is being carried on in three classes in order to give every competitor a chance of winning a prize, whatever his age or the size of his Outfit. In judging the models entered in this contest, general interest as well as neatness of workmanship will be taken into consideration, and handsome prizes are offered in each class. Entry forms giving full details of the competition can be obtained from Barber's Toy Store, and must be returned with the models submitted between Monday, 26th March, and Friday, 30th March.

ALL THE DIFFERENCE

Teacher: "Henry, are you learning anything?"
Henry: "Please, no, sir. I'm listening to you."

* * * *

Director of linoleum firm to prospective traveller: "You will be expected to cover the whole of England. Have you had any previous experience?"

"Well, sir, the biggest job I've tackled was covering bungalow floors."

* * * *

House-owner: "I'm glad you stopped complaining about the plaster falling."
Tenant: "It's all down now."

* * * *

Customer: "Is them aigs fresh?"
Market Woman: "I ain't sayin' they ain't"
Customer: "I ain't asked you, is they ain't. I'm asking you, is they is."

* * * *

Entering the kitchen, the mistress asked the maid, just from the country, what she thought of the electric fire and the electric cooker.

"They're real wonderful, mum," the girl replied. "They've neither of them gone out since I came here three weeks ago."

* * * *

"Have you ever been here before, sir?" asked the barber.

"Yes, once."

"I don't seem to remember your face, sir."

"Oh, it's healed up since then."

* * * *

Mrs. 'Arris (after a visit to the Zoo): "I thought I should 'a died o' laughing when we were at the Zoo to-day. Mrs. Perkins called an animal a seraph. Of course she meant a giraffe; but the fun of it was, it wasn't a giraffe, it was a camomile."

* * * *

He found his hair was leaving the top of his head, and took his barber to task about it. "You sold me two bottles of stuff to make this hair grow."

"It is very strange it won't grow again," said the barber. "I can't understand it."

"Well, look here," said the man, "I don't mind drinking another bottle, but it must be the last."

* * * *

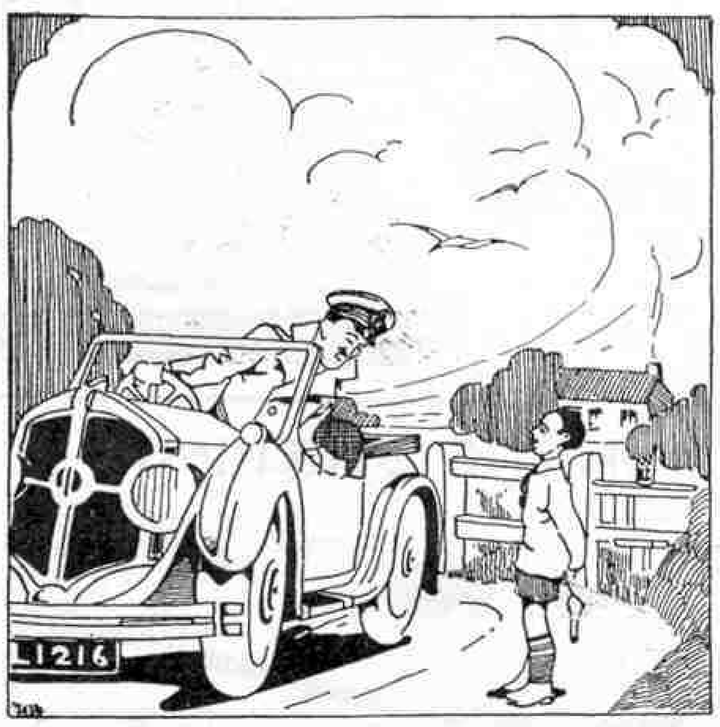
Mother (to son who is just being put to bed): "How I wish your father were at home to see how you behave when he's out!"

* * * *

Teacher: "Now, Jones, tell me which month has twenty-eight days."
Jones: "They all have, teacher."

* * * *

NOT AFTER BIG GAME



R.A.F. Officer: "Have you seen an aeroplane that came down somewhere near here, sonny?"
Small Boy (hiding catapult): "No sir. I've only been shooting at birds."

KEEPING IT DARK

The tiny boy had been taken for a motor ride by a friend of the family. On his return his mother said to him: "Did you thank Mr. Brown for taking you for a ride?"

There was no answer.

"Willie," she repeated, "did you hear me? Did you thank Mr. Brown for taking you for a ride?"

"Yes," whispered Willie, "but he told me not to mention it."

* * * *

Some unpopular relatives were visiting a couple and happened to mention their dog, a mongrel.

"He's just like one of the family," said the pup's proud mistress.

"Which one?" asked the hostess.

* * * *

First Villager: "There goes Bill Smith, Bill ain't the same man he used to be."
Second Villager: "No. And he never was."

* * * *

RELATIVITY

Conductor (in crowded bus): "Move farther up the car please!"
Youthful passenger: "It's not father; it's grandfather."

* * * *

"I say, waitress, there's a funny kind of film on this soup."

"Well, what do you expect for thruppence—Greta Garbo or Charlie Chaplin?"

* * * *

Caller: "Nellie, is your mother in?"
Nellie: "No, mother is out shopping."
Caller: "When will she return?"
Nellie (loudly): "Mother, what shall I say now?"

* * * *

The master was addressing the scholars on epidemics. Suddenly he pounced on a slumbering youth in the back row.

"Now, Williams," he said, "name something that spreads."

"Er-er jam, sir," was the sleepy retort.

* * * *

"Good gracious! What's this?" exclaimed the shooting baronet as something scuttled past his feet.

"A robert, Sir Rabbit," answered his nervous loader.

* * * *

A Chinaman was asked if there were good doctors in China.

"Good doctors!" he exclaimed. "China have best doctors in world. Hang Chang one good doctor; he great; save life of me."

"You don't say so! How was that?"

"Mee velly bad," he said. "Me callee Dr. Wan Lee. Give some medicine. Get velly, velly ill. Me callee Dr. San Sing. Give more medicine. Me glow worse—go die. Blimeby callee Dr. Hang Chang. He got no time; no come. Savee life."

HE KNEW!

The old gentleman was lost in a London fog, so thick that he could scarcely see his hand before his face. He became seriously alarmed when he found himself in a slimy alley.

"Where am I going?" he cried anxiously.

Out of the darkness came a voice: "Into the river I've just come out!"

* * * *

"How like his father he is."

"It's the weather," explained the baby's mother "usually he looks quite cheerful."

* * * *

The traveller entered what was apparently the only hotel in the forlorn looking town, and sat down.

Waiter: "Dinner is served, sir; will you have sausages on toast?"
Traveller: "No, I never eat 'em."
Waiter: "In that case, sir, dinner is over."

* * * *

Dentist (prodding a patient's gum in search of a fragment of tooth): "That's funny, I don't seem to feel it."
Patient (ironically): "You are lucky."

* * * *

"There's nothing fit to eat here, absolutely nothing," said the diner, examining the menu. "Bring me the manager."

"Very good, sir," said the waiter, who was under notice, "How would you like him, fried or grilled?"

* * * *

Landlady: "I think you had better board elsewhere."
Boarder: "Yes, I often had."
Landlady: "Often had what?"
Boarder: "Better board elsewhere."

* * * *

"Dad, what's a family tie?"

"Mine. Every time I want it one of you boys is wearing it."

* * * *

Tramp: "Yes, lady, I was an organist once."
Lady: "And what made you come down to your present state?"
Tramp: "My monkey died, lady."

* * * *

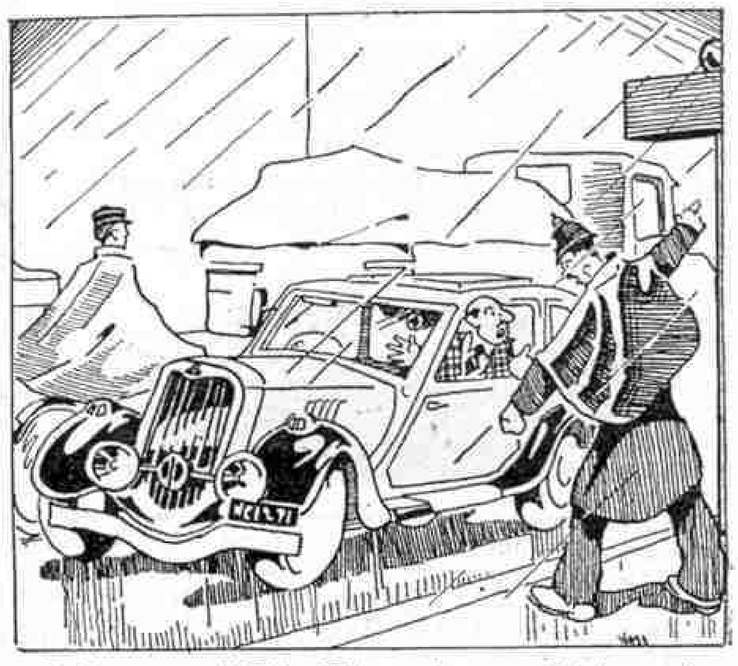
American: "It rained so much in New York once that we had to go about in small boats."
Englishman: "That's nothing. Once my farm was flooded, and I had to go down in a diving suit to milk the cows."

* * * *

"I saw a man playing on twenty pianos at once."
"Impossible! It couldn't be done!"
"Yes. He was a fireman and a piano factory was on fire."

* * * *

OBVIOUSLY!



Policeman: "Hi! Where do you think you're going? Can't you see this is a one way street?"
Motorist: "Vell, I'm going von vay, ain't I?"

From **5/-** pair

Turn your cycle into a real lightweight

Change those heavy metal mudguards, inflator, etc., for Bluemel light Celluloid Accessories. They never rust, chip or dent like metal. Made in black or white. Fully illustrated list post free. Fill in and send coupon below to :—

Bluemel's

POST NOW

(½d. post if coupon only is sent unsealed)

Dept. 27, WOLSTON, nr. Coventry

Name.....

Address.....

WRITE CLEARLY IN BLOCK LETTERS AS THIS

Meccano Motor Car Garage

Meccano model motoring would not be complete without some means of accommodating cars when not in use, and the Meccano Garage has been specially produced for this purpose. In addition to providing accommodation for any Meccano model car, it can also be used for housing other model cars of suitable size.

Meccano Motor Car Garage

The Meccano Motor Car Garage is strongly built, with imitation rough cast finish. Its double doors are rigidly made and firmly hinged.

The inside dimensions of the garage are as follows : Height, 5″. Length, 13″. Width, 7¾″. Price **7/-**

Meccano Aeroplane Hangars

The Meccano Aeroplane Hangars are well constructed models, realistic in appearance and beautifully finished. They have been introduced for the purpose of housing aeroplane models made with the No. O and No. O1P Meccano Aeroplane Constructor Outfits, and other models of suitable size. Each Hangar is strongly built, with imitation rough cast finish.

PRICES

No. O1 AEROPLANE HANGAR will accommodate one model made with the No. O or No. O1P Outfits. Length, 11½″. Depth, 10½″. Height, 4½″. Price **5/6**

No. O2 AEROPLANE HANGAR will accommodate two models made with the No. O or No. O1P Outfits. Length, 21½″. Depth, 11″. Height, 6½″. Price **7/6**

Meccano Aeroplane Hangar No. O2

5 Wonderful Offers from

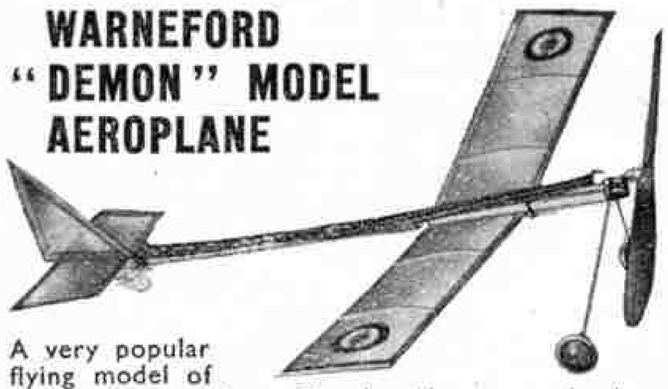
LARGEST STOCKS OF MECCANO OUTFITS AND HORNBY TRAINS IN THE KINGDOM.

GAMAGES

NEW HORNBY LOCOS FOR OLD! Send for leaflet which gives full details of this most attractive scheme.

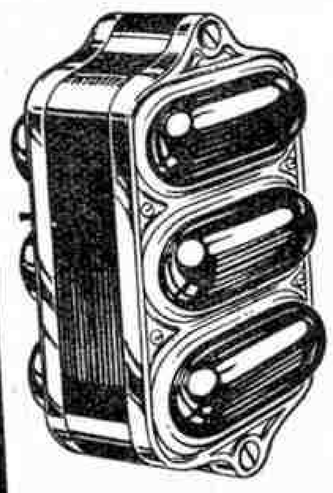
National Headquarters for Meccano and Hornby

WARNEFORD "DEMON" MODEL AEROPLANE



A very popular flying model of sturdy construction. Fitted with patent shock-proof chassis, and covered with yellow proofed silk. Will rise from the ground and has a flight of 300 yards, undoubtedly a fine performance for a machine of this price. Wing span, 23 in. Length, 25½ in. 10-in. propeller. Price 7/6 Post 9d.

Unique Opportunity for MODEL RAILWAY ENTHUSIASTS



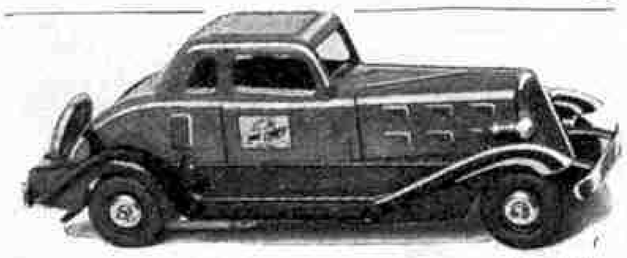
Ideal Railway Signals from Motorists' Direction Lamps

These lamps make perfect signals and, of course, at this price are amazingly cheap. They are finished in chromium plate and black and measure 3 in. x 5½ in. over all. Very similar to the Metropolitan Railway signalling systems, and provided with red, amber and green lights on both sides. Complete with three 12 volt bulbs. As illustrated. Post 6d. Price each **1/3**

A REAL MODEL BOAT For the Price of a Toy

This entirely new model yacht folds up and erects easily into the remarkable size of 2½ ft. high, 2¼ ft. long, with approximately 300 square inches of sail area. Rigged Fore and Aft. Will carry a cargo of 2½ lb. Guaranteed to sail.

Price **7/6** Post 1/3



WONDERFUL CLOCKWORK MOTOR CAR

(Exclusive to Gamages.)

A perfect model in heavy gauge metal with particularly strong clockwork movement. Four outstanding features. 1. As car runs at high speed a siren is automatically sounded. 2. Two electric head lamps which are operated by a switch to either **"bright" or "dim."** 3. Brake on rear wheel. 4. Car can be steered straight or in a circle. Overall length, 14 in. Price complete with 2 Batteries Post 1/- **12/6**

Foreign.

LAUNCH WITH AUTOMATIC STEERING

The amazingly clever feature of this clockwork-driven boat is that it will go out in a straight line, almost 150 ft. and **RETURN AUTOMATICALLY.** Speed is 100 ft. per minute, and it cuts through the water just like the real speed boats. Length, 17 in. overall. Price **18/6** Post 9d.

Foreign.

GAMAGES, HOLBORN, LONDON, E.C.1 *Telephone: Holborn 8484. City Branch: 107, Cheapside, E.C.2*

Competition Corner

ADVERTISING SLOGANS

Some years ago we announced a competition in which readers were invited to try their skill in inventing a new slogan to be used in the advertising of Meccano. The contest proved very popular and we believe that the time is ripe for another of the same type. We are carrying the idea rather further on this occasion, however. Instead of restricting competitors to the range of Meccano products for their slogan, we allow them to choose any article or service advertised in this issue of the "*M.M.*"

It may be well to explain first of all the nature and the purpose of an advertising slogan. Briefly, it is a catch-phrase, a short string of easily-remembered words that set forth concisely some point of merit claimed for the goods or service advertised. Among famous slogans that will be well known to our readers are:—"Meccano—Engineering for Boys"; "Seccotine Sticks Everything"; "Bovril Prevents that Sinking Feeling."

The word "slogan" itself is derived from the ancient Scottish "*Sluagh-gairm*," a rallying call. In the days of hand-to-hand warfare the battle always raged fiercest around the Standard; and when the battle was going against them, and their Standard was in danger of capture, the old Highlanders bellowed their "sluagh-gairm" to rally their forces. The "slogan," in fact, is the advertiser's battle cry.

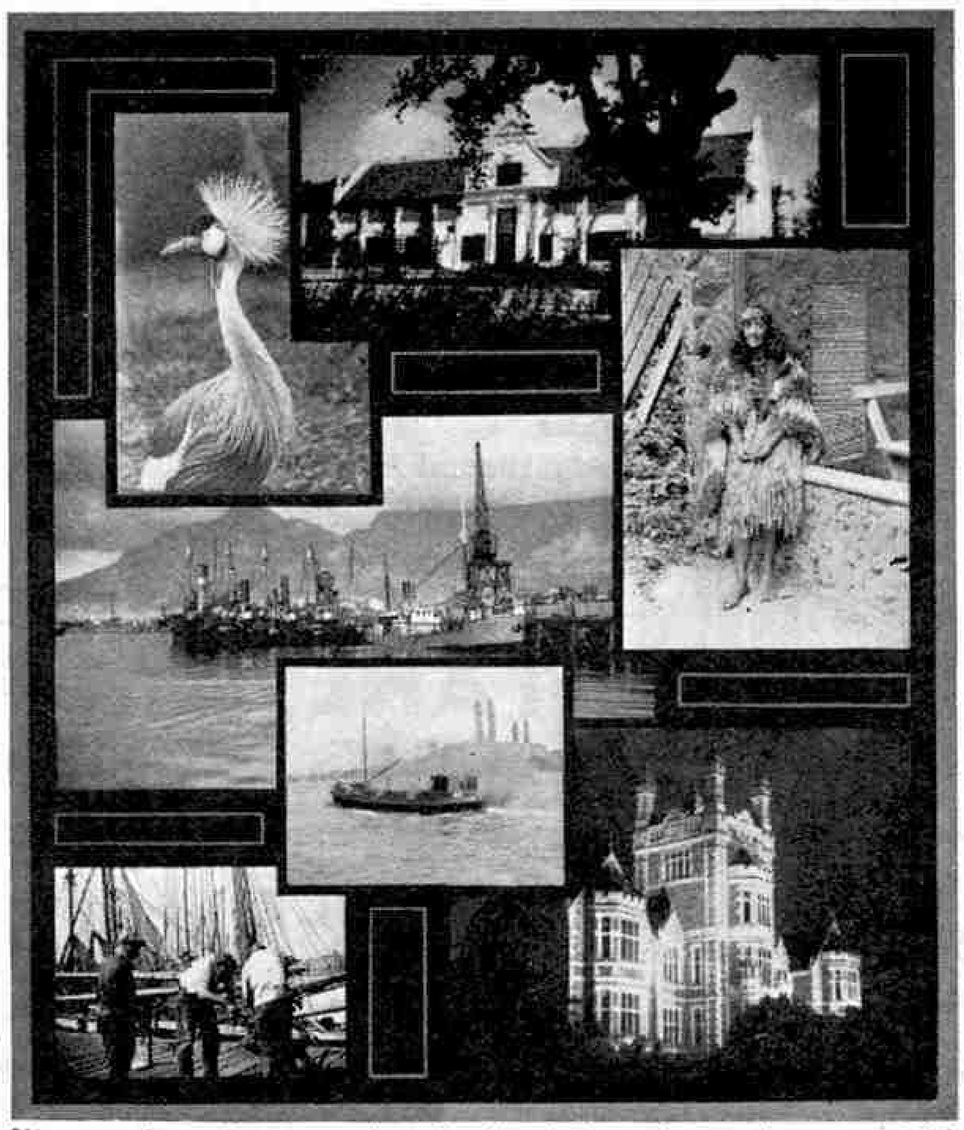
From the fact that a slogan must be easily remembered after it has caught the eye, it is obvious that it must be short. Four or five words are the ideal; anything larger tends to be cumbersome, although it is true that there have been brilliant slogans of six and even seven words.

In this contest readers may submit as many slogans as they wish for each or any of the products, but no competitor may gain more than one of the awards. These will consist of Meccano products—this term covers all goods manufactured by Meccano Limited—chosen by the winners themselves to the value of 21/–, 15/–, 10/6 and 5/–, to be awarded to the four best slogans in order of merit. In addition there will be a number of consolation prizes.

Competitors should take care to indicate the particular product to which each slogan applies. If the name is not an integral part of the slogan, it should be given in brackets at the end.

Entries must be addressed "Slogan Contest, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 31st March. A separate set of prizes will be reserved for entries from Overseas readers. These must arrive not later than 30th June.

Readers may submit as many entries as they wish, but no competitor may receive more than one prize.



We reproduce above a series of prizewinning pictures from the 1933 Photographic Competitions. 1. A crowned crane (A. A. Boult, Auckland, N.Z.; May Contest). 2. Bien Donne and (3) Whalers at Rest (J. Credie, Capetown, S. Africa; August and June). 4. A Maori Guide (A. A. Boult, Auckland, N.Z.; April). 5. A Thames Scene (C. H. Clary, Cubitt Town, E.14; August). 6. Mending their Nets (A. J. R. Peacock, Cheltenham; September). 7. Floodlighting (G. P. Scott, Dunedin, N.Z.; August). The 1934 Photographic Competitions will begin next month.

March Drawing Contest

The open subject Drawing Competitions that we have featured in the "*M.M.*" from time to time have always proved very popular, and in response to many requests we announce another such contest for this month.

The prizes will consist of Meccano products or Artists' Materials to the value of 21/– and 10/6 to be awarded in each of the usual two sections, A for competitors aged 16 and over, B for those under 16.

There will be no restrictions as to the subject, and entries may be in black and white or in colour. Competitors may submit as many entries as they wish, but each drawing must bear the competitor's name, age and address on the back. It is not sufficient merely to indicate the section A or B; the exact age must be given, as this point is taken into consideration in awarding the prizes.

Entries must be addressed "March Drawing Contest, Meccano Magazine, Binns Road, Liverpool 13," and must reach this office not later than 31st March. Overseas readers are particularly invited to take part, and a separate set of prizes of the same values and to be awarded in similar conditions, will be reserved for them. The closing date for Overseas entries will be 30th June.

Prizewinning entries normally are retained by the Editor, but unsuccessful entries will be returned at the close of the competition if a stamped addressed cover of suitable size is sent for the purpose.

It is a condition of entry that the Editor has the right to reproduce any entry in the "*M.M.*" without fee.

Competition Results—(*Continued from column 3*)

October Silhouettes Contest.—1. R. B. Latimer (Burma); 2. R. J. Gerrard (Sydney, N.S.W.); 3. N. Johnson (Toronto); 4. S. B. Garner (Auckland, N.Z.).

Tall Story Contest.—1. G. Dubois (Montreal); 2. B. L. Cowan (Capetown); 3. L. P. Sampson (Paris); 4. J. Harrington (Sydney, N.S.W.).

COMPETITION RESULTS

HOME

Advertisement Jig-Saw Contest.—1. M. H. Gould (Camberwell, S.E.5); 2. J. C. Goudie (Manchester) 3. H. A. Williams (Putney Vale, S.W.15); 4. R. Banks (Campbeltown). Consolation Prizes: J. Bryce (Bath); E. Frith (Frodsham); I. McCartney (Belfast); N. Reed (East Grinstead); T. F. Smith (Nottingham); R. E. Williams (Norwich).

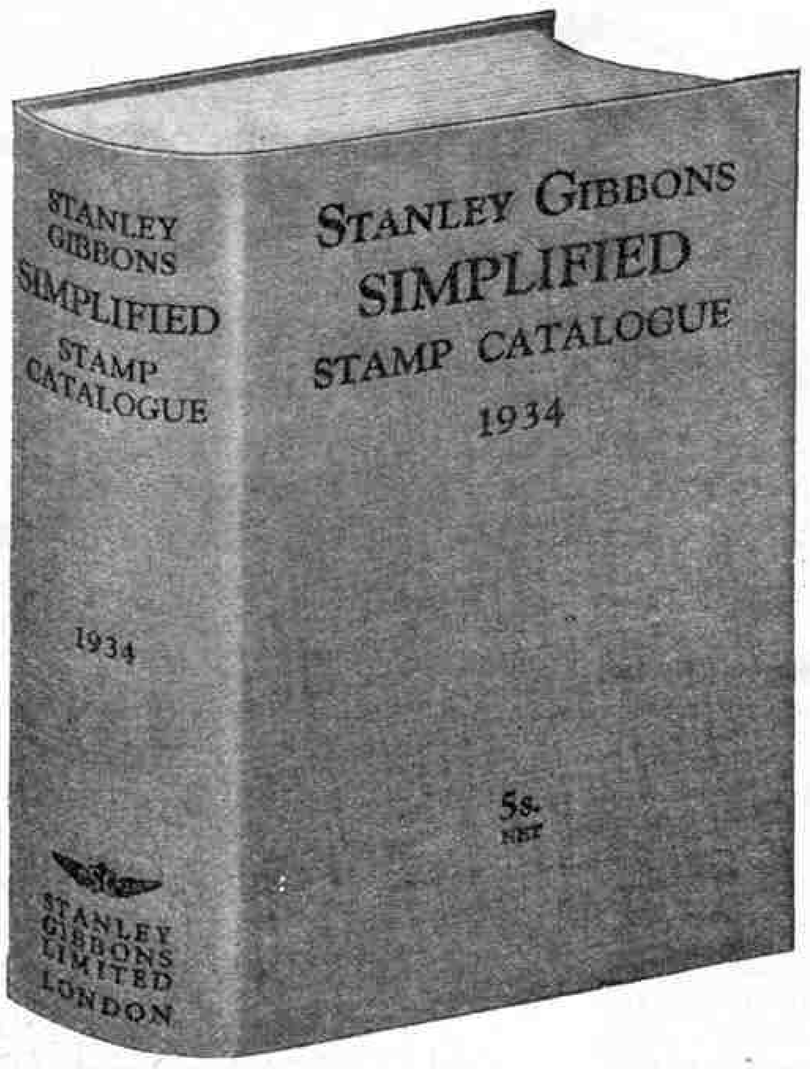
December Drawing Contest.—First Prizes: Section A, T. R. Simm (Charlton, S.E.7); Section B, R. Simpson (Biddulph); Second Prizes: Section A, D. I. Vickery (Sale); Section B, J. Macken (Bromley); Third Prizes: Section A, A. E. Lukey (London, N.W.1); Section B, V. Lemaistre (Dundee). Consolation Prizes: B. Davies (Kingstown); A. McDonald (Giffnock); A. Masters (Leyton, E.10); R. Mills (Cheadle).

Conundrums.—1. G. C. Rider (Bournemouth); 2. E. Rigby (Liverpool); 3. D. Figgins (Pembroke Dock); 4. P. Parish (Rugby). Consolation Prizes: H. W. Kennett (Dartford); G. Lawley (Watford); G. Ransom (Cowes); J. Sisson (Preston); M. Roy (Edinburgh); W. Whitaker (Hornsea).

OVERSEAS

October Drawing Contest.—First Prizes: Section A, W. Figgins (Timaru, N.Z.); Section B, R. J. Dickison (Dunedin, N.Z.). Second Prizes: Section A, J. S. de'Conti Manduca (Malta); Section B, V. Garcia (Trinidad).

(*Competition Results Continued in column 2*)



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We will give you **FREE** a packet of **15 different Canada** including the rare and beautiful **Postal Congress Pictorial** (see "M.M.," page 901, November, 1933). Just send 2d. for postage and request our Approval Sheets. *You will be glad you sent.*

SHIRLEY STAMP CO.,
19, Sandringham Avenue, London, S.W.20.

Air Mail Stamps, 25, 8d.; 50, 1/9; 100, 6/3. Record value.—T. H. Smith, 63, St. Kilda Road, Ealing, W.13.

FINE BRITISH COLONIALS—BARGAIN PACKETS. 24 Australia, 9d.; 50 Canada, 1/6; 30 New Zealand, 1/-; 15 Malta, 6d.; 20 Straits, 9d.; 12 Malay, 6d.; British Colonials at ½d. and 1d. each a speciality. Ask to see these special approvals.—**S. F. Bickers, "Elveden," Lordswood Avenue, Southampton.**

"WORTH WHILE"

100 DIFFERENT BRITISH COLONIALS 1/- Post Free

including Gold Coast pictorials, ½d., 1d., 1½d., 2d.; N. Rhodesia, 1d., 2d.; Nigeria, ½d., 1d., 1½d., 2d., 3d.; Mauritius, 2, 4, 5c.; Iraq, ½, 1, 3 annas; N. Zealand, ½d., 1d., 1½d., 2d., 3d., 4d., 6d., 1/-. Newfoundland, Palestine, Jamaica, Fiji, Bahamas, etc., etc. Finest packet YOU have ever had. MONEY BACK if not satisfied. Ask for "Worth While" Approval Sheets.

JOS. H. GAZE, DIDSBURY, MANCHESTER.

THE FIRST STAMP EVER ISSUED

was the British 1840 Penny Black. Against a P.O. 1/9 we will send you a genuine postally-used copy of this interesting stamp (cat. 6/-); for a further 5/- you may have a copy of its companion stamp, the 1840 2d. Blue (cat. 20/-). Another "classic" which every Collector should have is the **Cape of Good Hope** 4d. blue **Triangular** (cat. 15/-), and a nice copy will be supplied at 5/-. Superb approvals of any country against satisfactory English references or a deposit. **Full Lists Free.**

NORRIS & CO. (Dept. M), Norwood, London, S.E.19.

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A wonderful packet of AIR STAMPS (usually sold at 1/6), given FREE to all collectors sending a card requesting our approvals. The finest AIR MAIL packet ever offered to collectors. DON'T MISS IT.

AIR MAILS

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Union S. Africa. 30 diff., 1/-, 2d. postage. Postal Order. —Williams, 435, Prince Alfred, Maritzburg, Natal.

GENUINE BARGAINS! all diff. Post 1½d. extra.
India, 1a. mint Tête-Bêche, pair, scarce 1/-
9 Charkhari Pict. ... 9d. 5 Large Cochin ... 2d.
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PUCKA STAMP CO., 27, Normandy Avenue, Barnet.

I WILL SEND YOU 1,000 DIFFERENT STAMPS

on approval, from which you may select any 100 for 3/-. These Stamps are **EXCELLENT VALUE** and include some catalogued at 1/- each or more.
MORE ADVANCED Collectors are invited to send for better class selection on approval, priced at one-fifth to one-third Catalogue.

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£25 in Cash Given Away. No Snag.
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ERRINGTON & MARTIN WHOLESALE & RETAIL STAMP DEALERS AND PHILATELIC PUBLISHERS ESTABLISHED 1880
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A fine packet of all different Stamps containing **Manchukuo,** 1932 ½ fen pictorial, **French Indo China Air Mail,** unused, **Eritrea,** 1930 2c., large pictorial **Somali Coast, Tunis** 1933, new issue, **Turkey** pictorial, **Brazil** pictorial, **Nigeria, Portugal, Ceylon,** etc., **free** to all asking to see my famous Approval Sheets and enclosing **2d. for postage. (Abroad 6d. P.O.)**

Albums, **1/4, 2/6, 5/-** and upwards.

S. HAMMOND, CHESHAM FIELDS, BURY, LANCS.

FREE! To genuine approval applicants, 30 stamps, including Mexico, Old Spain, Mint Basutoland, etc.—Shakeshaft, "Homeleigh," South Rd., Preston, Brighton.

YOUR CHANCE! The finest value ever offered in real bargain Approvals. Thousands different on sheets at ¼d., ½d., and 1d. each. Fine range in books from 1½d. to 2/6. Prices average ⅛th Gibbons. Write now for a pleasant surprise! State "Wants."

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1000 THE "1000" PACKET

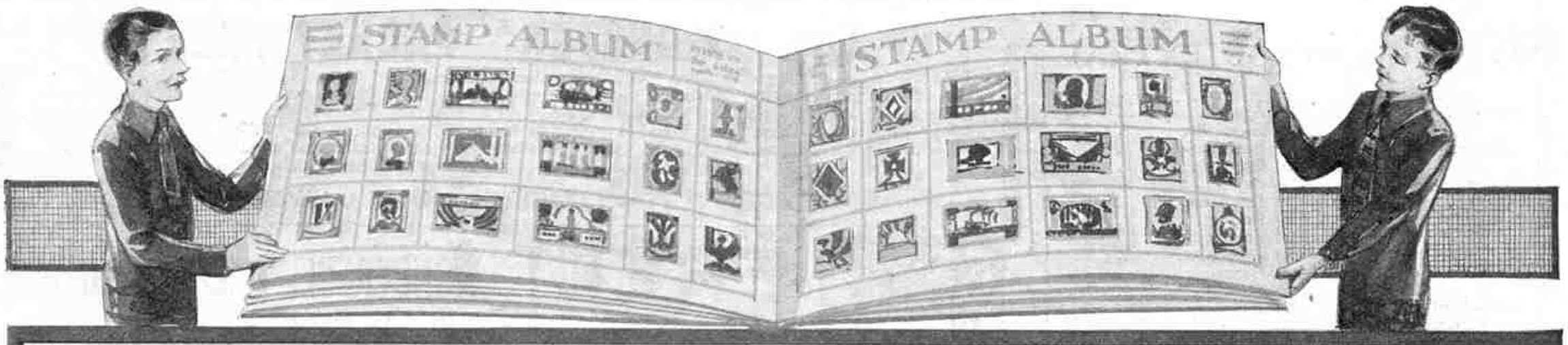
5d. Postage 2½d. Abroad 6d. extra.

THE CHEAPEST OFFER EVER MADE

FOR 20 YEARS I HAVE ADVERTISED THIS PACKET AND IT IS STILL MY BEST SELLER.

Contains **500 Excellently Assorted Foreign Stamps, 25 B. Colonials** (catalogued at 2/-), a complete sheet of **100 Unused** (useful for exchanging), **375 Strip Mounts** which mount stamps three times as quickly as any other method, a **12 Page Duplicate Book** (to hold 120 stamps). The lot **5d.,** postage 2½d. (abroad **6d.** extra). Ask for Approvals. Senders of collectors' addresses receive **10 Persia Free.**

H. C. WATKINS (M. DEPT.), GRANVILLE ROAD, BARNET. *Your money back if not satisfied.*



STAMP COLLECTING

HOW STAMPS ARE PRINTED

Since the printing of a stamp is productive of so much of the higher interest that a stamp collector derives from his hobby, we propose in this article to deal briefly with the several printing processes that are commonly employed in stamp production to-day. These are Line-Engraving (sometimes known as Intaglio or Recess Printing), Typography (or Surface Printing), Lithography and, to a less but increasing extent, Photogravure.

The 5m Egyptian International Navigation Congress issue of 1926. This issue was printed by "offset lithography."

In Line Engraving the design of the stamp is cut into the metal of the printing plate, the lines of the design being represented by shallow recesses. In printing, the plate is inked and the surface wiped clean, so that only the inked recesses leave an impression on the paper, which is brought into contact with the printing plate under pressure that forces it into the recesses. Examination under a magnifying glass will reveal the ink standing up in minute ridges on the surface of the paper. In extreme cases the ridges are visible to the naked eye.

The preparation of the printing plate for this process is extremely interesting. The first stage is the cutting of the original or master die. This is done by hand on soft metal, the design being cut in reverse, of course, and appearing just as the printed stamp itself would look if it were viewed in a mirror.

10c. Norway 1930 St. Olaf Commemorative. Typographed.

After the master die has been hardened, a roller of very soft steel is rocked to and fro across it until it has acquired a positive impression on its surface. This roller in turn is hardened, and then rocked on the printing plate itself, a sheet of soft metal, until a negative design is reproduced. This process is repeated until the plate has received as many impressions as it is intended the sheet of stamps should contain. After hardening, the plate is ready for printing.

Obviously if each reproduction of the master die is perfect it will be impossible to detect from which section of the printing plate any given stamp has been printed. If a faulty reproduction is made it is necessary for the engraver to retouch that part of the printing plate, which is done by scraping away the soft metal and re-engraving the faulty part. It is almost impossible for the engraver to repeat the damaged lines as in the master die, and thus the stamps produced from the altered part of the plate will vary in detail from the others. Such stamps are keenly sought by specialist collectors, and the evidences of the alterations to the plate are known as "retouches."

The "re-entry" variety arises in a similar way. It is important that each impression from the roller should be very accurately placed on the printing plate so that the finished stamps shall be well centred between their perforations. Occasionally it happens that the roller die is rocked in a slightly wrong position, too high, too low, or too far to one side; and it is necessary to scrape off the faulty impression and re-enter, that is, re-rock the roller in the correct position. If any traces of the faulty impression are left on the plate they will be reproduced in the printed sheet, thus providing what is known as the "re-entry" variety.

Italy's 21 1930 Air Mail issue. Printed in photogravure.

There have been cases of whole designs being doubled in this way—there was an example in the printing of the 1½d. value of New Zealand's South African commemorative issue—but more frequently "re-entries" are to be detected in the doubling of a frame line.

The lower values of Spain's 1930 "Columbus" issue were lithographed. This is a 2c. value from that issue.

In the Typographical process the preparation of a master die is again the first stage, but in this case the lines of the design are in relief, that is, formed by ridges of metal standing up from the surface of the die, which is a negative. From this negative die a mould of *papier-maché* or other suitable material is prepared, and the necessary number of reproductions in metal are cast from the mould. Alternatively the reproductions for this process may be made by electrotyping, and in this case a wax impression is taken from the master die. A thin shell of copper that reproduces faithfully every detail of the master die is formed by electro-deposition on this mould, and when suitably strengthened and mounted is ready for printing.

80c. Vatican City 1929. Printed in photogravure.

Any number of reproductions can be produced by either the stereotyping or electrotyping processes, and the printing plate is made up by locking together the requisite number of reproductions, or "*cliches*" as they are termed.

Great Britain's Postal Union Congress issue 1929, 2½d. value. Typographed.

The reproduction of the *cliches* is purely a mechanised process, so that there is only a very small risk of a variety arising. The principal risk lies in wrongly placing the *cliches* when forming the printing plate. It is possible to invert one or more in relation to the remainder, and thus create a *tête bêche* error.

In the Lithographic process the printing surface and the background of the stamp are in the same plane on the printing medium, and often the result is inclined to be dull and flat. Many excellent productions are to the credit of the process, however, notably the early Greek stamps.

In this process the printing *Continued on page 255*

SETS (POSTAGE EXTRA)

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For further Stamp Advertisements see page 264

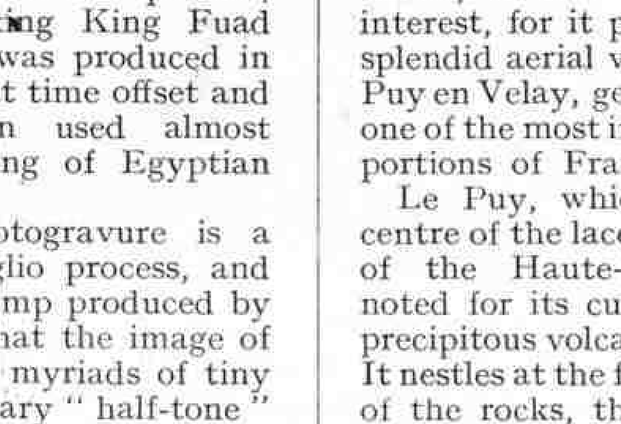
Stamp Collecting—*(Continued from page 253)*

medium is an absorbent " stone," which is more frequently a zinc or aluminium sheet than a slab of mineral. The design is drawn on the surface of the stone with lithographic chalk, a very greasy type of crayon. The greasy image attracts the ink when in contact with the inking roller of the printing press, but the dampened stone, although in the same plane, repels the ink. Thus, when the paper is brought into contact with the printing surface, only the inked design is registered.

Offset lithography, more commonly termed " offset," is a recent variant of the process. In this process the original drawing on the stone is a positive, and a rubber roller acts as the intermediary in transferring the inked design from the stone to the paper. Minor varieties are not infrequent in stamps produced by this process, due to the entry of the human element into the preparation of the stone.

The striking Egyptian " Conference " commemoratives of 1925/7 were produced by offset lithography. Egypt indeed has played a pioneer part in stamp production and, doubtless owing to King Fuad's keen interest in philately, was one of the earliest countries to use the most recent process, Photogravure. The striking King Fuad portrait issue of 1923–4 was produced in this process, and since that time offset and photogravure have been used almost exclusively in the printing of Egyptian stamps.

Strictly speaking, photogravure is a development of the intaglio process, and careful inspection of a stamp produced by photogravure will show that the image of the design is built up by myriads of tiny dots of ink as in the ordinary " half-tone " process used to illustrate the *"M.M."* and other magazines and newspapers. These dots are produced by the interposition of a screen of fine lines between the copper printing plate and the subject that is being photographed on to it. But whereas in commercial half-tone work the finest screen is one consisting of 150 lines to the inch, in photogravure 150 lines is the coarsest screen used. For very fine detail in gravure work as many as 400 lines to the inch may be used. There is a difference in the processes also in that instead of being placed in the camera, the screen in gravure is printed on a carbon tissue that is used to convey the image to the copper plate after photographic transparencies have been made of the original subject.



After the image has been transferred to the copper plate it is etched in acid, and the tiny squares resolve themselves into pockets on the plate, varying in depth with the depth of tone of the subject. When the ink is applied to the plate it fills these pockets, and thereafter the printing process is similar to that used in ordinary recess printing.

Stamp Gossip
and Notes on New Issues

The German Wagner Issue

In addition to the stamps described in our article in the February *"M.M.,"* Germany included in its Wagner commemorative series a special postcard franked with a 6 pf. + 4 pf. non-adhesive stamp showing a portrait of the composer. The postcard was illustrated with a view of the Festival Theatre at Bayreuth built by Wagner for the production of his operas.

The release for public sale of a number of sheets of the Wagner stamps, originally made up for sale in booklets, has resulted in the provision of a number of interesting varieties. One form of the sheets contains rows of the 4 pf. + 2 pf. and the 6 pf. + 4 pf. alternately. There are 10 such rows and the upper five are inverted in relation to the lower five. Thus the fifth and sixth rows provide a series of unusual *tête bêche* and *se tenant* varieties.

A New French Pictorial Stamp

Without preliminary announcement France has issued a new pictorial stamp, 90c. value. The design, as our illustration shows, is of exceptional interest, for it provides a splendid aerial view of Le Puy en Velay, geologically one of the most interesting portions of France.

Le Puy, which is the centre of the lace industry of the Haute-Loire, is noted for its curious and precipitous volcanic rocks. It nestles at the foot of one of the rocks, the Rocher Corneille, 435 ft. in height, the pinnacle of which is surmounted by a gilded statue of the Virgin and Child cast from the metal of 213 cannon captured at Sebastopol.

This rock is shown in the background of the stamp. The left foreground is occupied by the Rocher d'Aiguille, another natural pinnacle, 280 ft. in height, at the top of which stands the tiny church of St. Michel d'Aiguille, dating back to 962 A.D.

An Egyptian Air Commemorative

The stamps issued in December by Egypt to commemorate the International Air Congress at Cairo are worthy additions to the range of Egyptian commemoratives.

There were five stamps in the series, 5, 10, 13, 15 and 20 milliemes. The first two used the design shown here, a view of an Imperial Airways " Atalanta " type monoplane as used on the African sections of the London-Capetown route. The 13m. and 15m. show the Dornier Do-X flying boat and the 20m. a view of the famous German airship *"Graf Zeppelin."*

American New Issues

Three new stamps have appeared almost simultaneously in the U.S.A. The first, illustrated here, is a 50c. air stamp for use on mail carried by the *"Graf Zeppelin"* on its recent flight through the United States

to the Chicago Exhibition. The stamp is severely simple in design and shows, in addition to the airship, the Federal Building at Chicago and *" Graf Zeppelin's "* hangar at Freidrichshafen.

The second stamp, a 3c. value, is to commemorate Commander Byrd's latest expedition to the Antarctic. The stamp has a most interesting design, the principal feature of which is a globe bearing inscriptions recording the dates of Byrd's previous exploration flights, as follows: 1. (1926) to the North Pole; 2. (1927) across the Atlantic; 3. (1929) to the South Pole. Finally, the proposed route for the present flight is indicated.

The third stamp is the 5c. General Kosciusko commemorative, celebrating the 150th anniversary of the naturalisation of this Polish-born commander in the American War of Independence.

The New British Stamps

Several readers have written to enquire when the new British stamps printed in photogravure by Messrs. Harrison and Sons will be placed on sale.

These stamps were to have been issued in the early days of this year, but it is understood that unavoidable delays have occurred and the first new printings will not be available until July.

First Colonial Issues

The collector of British Colonials has two new names to add to his list of countries, Bahrein and Basutoland. For the present the former is issuing overprinted Indian stamps, but Basutoland, contenting itself with one design for its first issue, has produced one of the neatest Colonial designs we have ever seen. As our illustration shows, there is an excellent grouping of the pictorial and inscriptive elements.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

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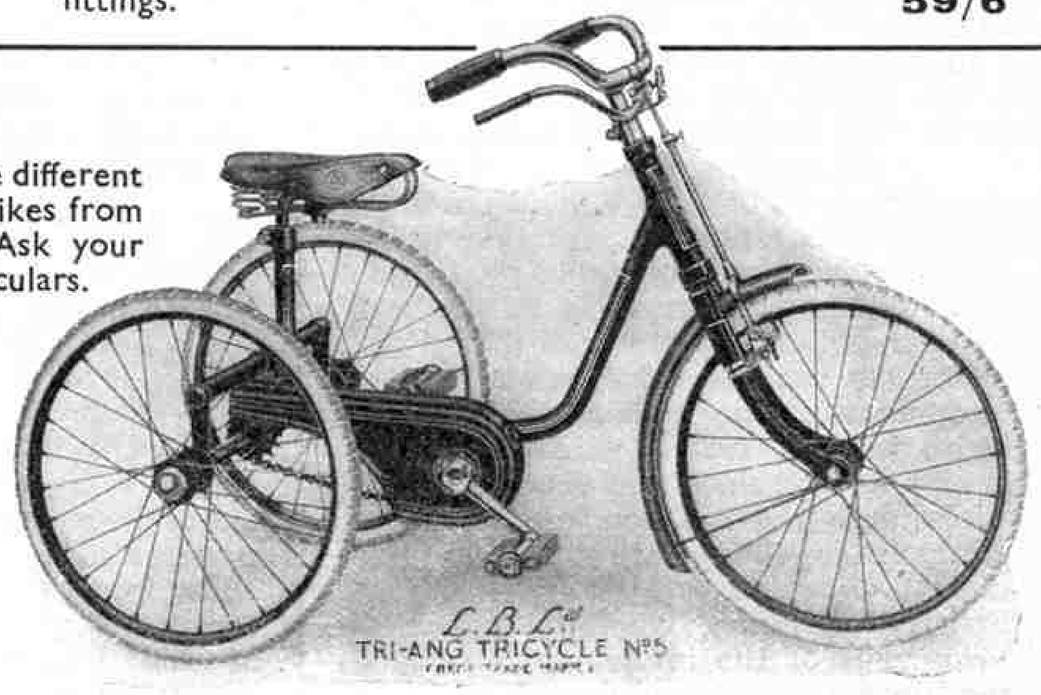
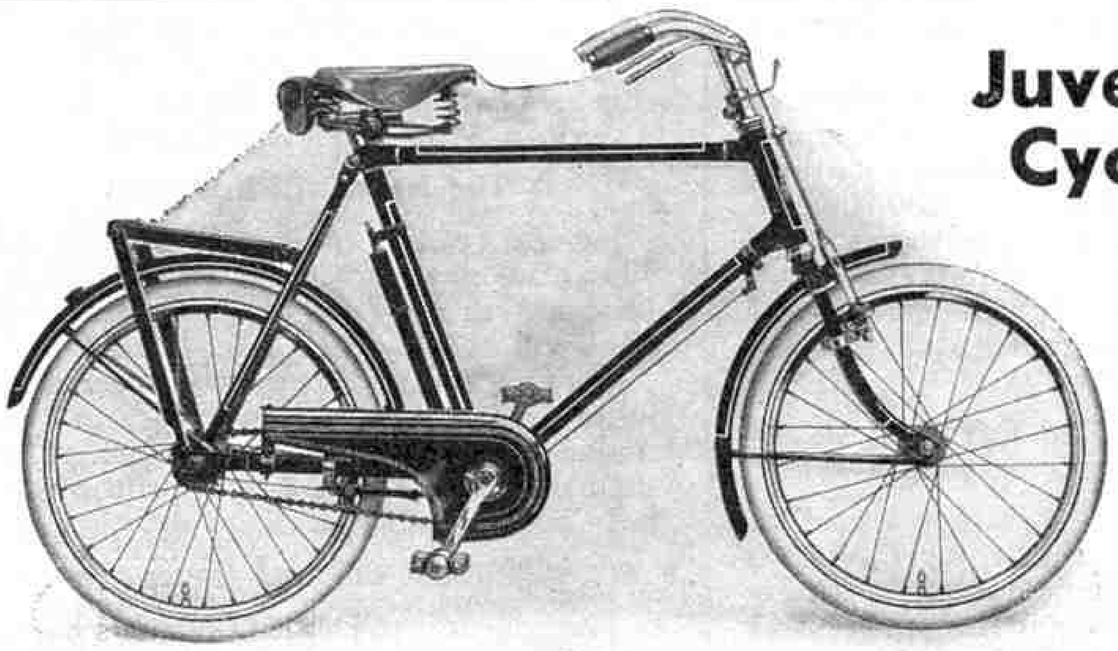
There are twenty-five different models of Tri-ang Trikes from which to choose. Ask your dealer for particulars.

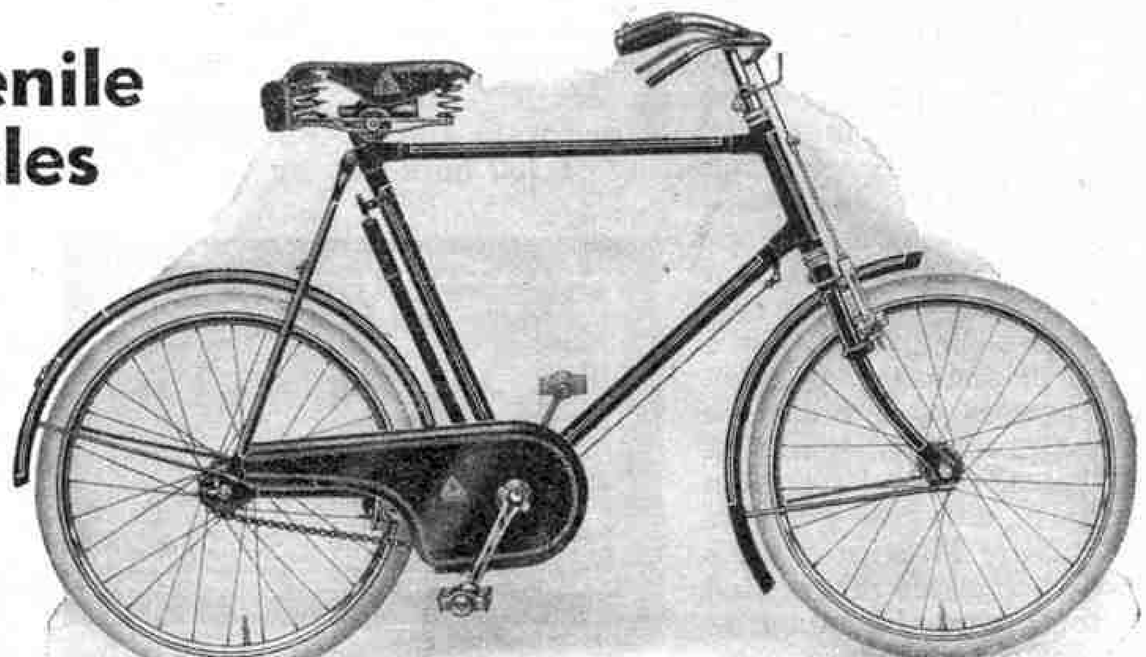


TRI-ANG TRICYCLE No. 5. Cycle-chain drive with free wheel. Frame of best quality weldless cycle tubing. 14″ wheels with 1⅛″ sponge tyres. Ball-bearing pedals. Coil-spring saddle. Finished black or blue cycle enamel, gold lines. Chromium fittings. **59/6**

Juvenile Cycles



JUVENILE CYCLE No. 9. (Boy's). Frame of best quality weldless steel cycle tubing. Adjustable ball-bearings throughout. 16″ x 1⅜″ Dunlop pneumatic tyres on rustless tangent spoked wheels. Two rim brakes. Raised handlebars ½″ x ⅛″ cycle roller chain. Three coil saddle. Black or blue. Chromium plated fittings. **59/6**



JUVENILE CYCLE No. 14 (Boy's). Larger than the Fairycycle, 18″ frame, for ages 8-12. Finest quality British tube. 18″ x 1⅜″ Dunlop pneumatic tyres. Three coil leather saddle. ½″ x ⅛″ roller chain. Ball-bearings throughout, two rim brakes. Free wheel. Black or blue. Usual bright parts chromium plated. **63/-**

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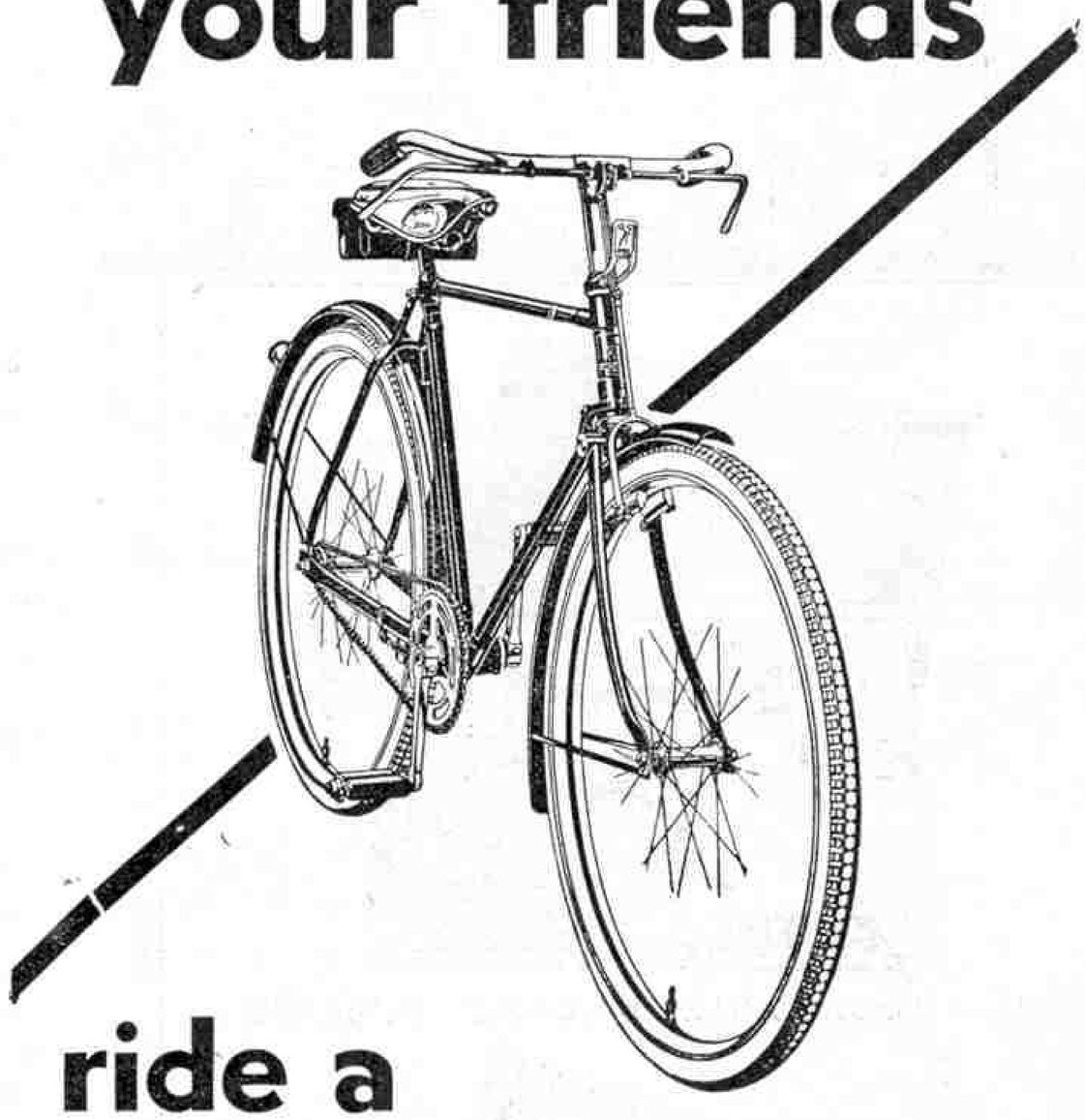

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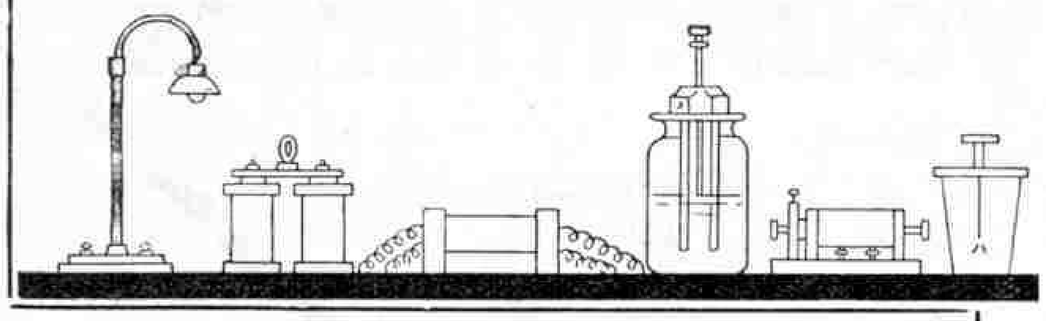

In these days of radio, X-rays, and electric trams and trains, every boy should have a knowledge of electricity. The only way to gain this knowledge is by means of experiments, and the Meccano Elektron Outfits have been produced specially for this purpose.

These Outfits contain all the materials for carrying out a splendid series of fascinating experiments, commencing with Magnetism and passing on through Frictional Electricity to Current Electricity. In addition many interesting mechanisms can be constructed, including an Electric Bell, a Telegraph, and a Shocking Coil.

No. 1 Meccano Elektron Outfit Price 8′6

No. 1 MECCANO ELEKTRON OUTFIT

Magnetism and Static Electricity

The No. 1 Outfit contains two powerful Bar Magnets and a reliable Magnetic Compass, together with everything necessary for the carrying out of a series of fascinating magnetic experiments. In addition there are materials for experiments in frictional or static electricity, and for the construction of an Electric Compass and two forms of Electroscope.

Price **8/6**

No. 2 MECCANO ELEKTRON OUTFIT

Magnetism, Static and Current Electricity

The No. 2 Elektron Outfit contains all that is included in the No. 1 Elektron Outfit, with additional parts that enable a splendid series of experiments in current electricity to be performed. Among these parts are a Horseshoe Magnet, and Coils and Yokes for the construction of Electro-Magnets that can be used in building a real Electric Bell, and a Buzzer for use in an electric telegraph system.

Price **25/-**

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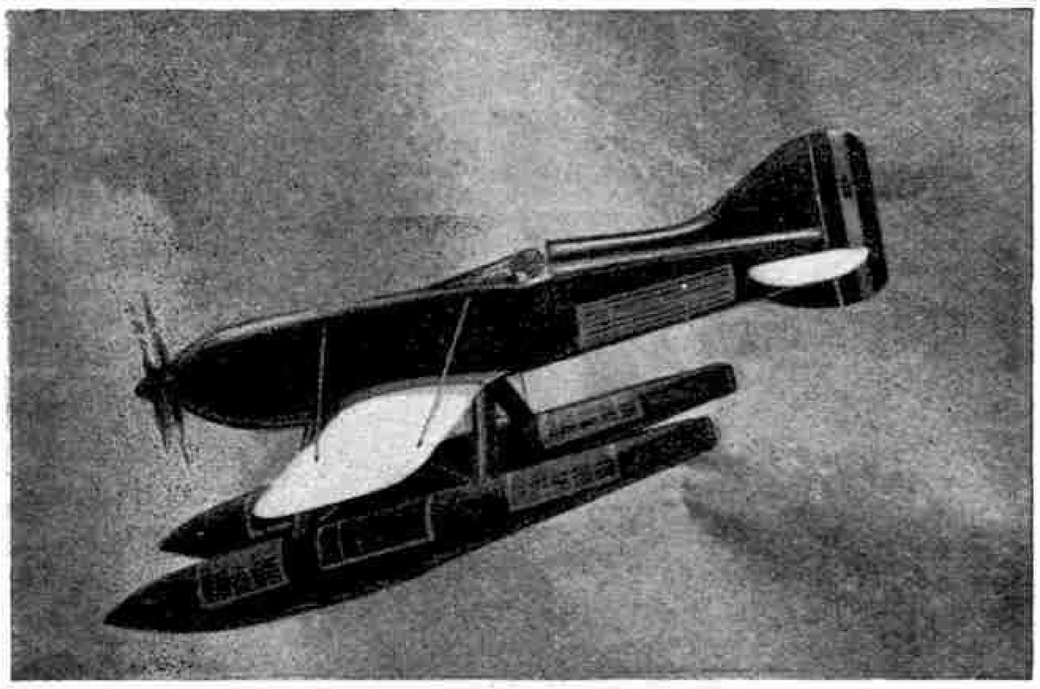

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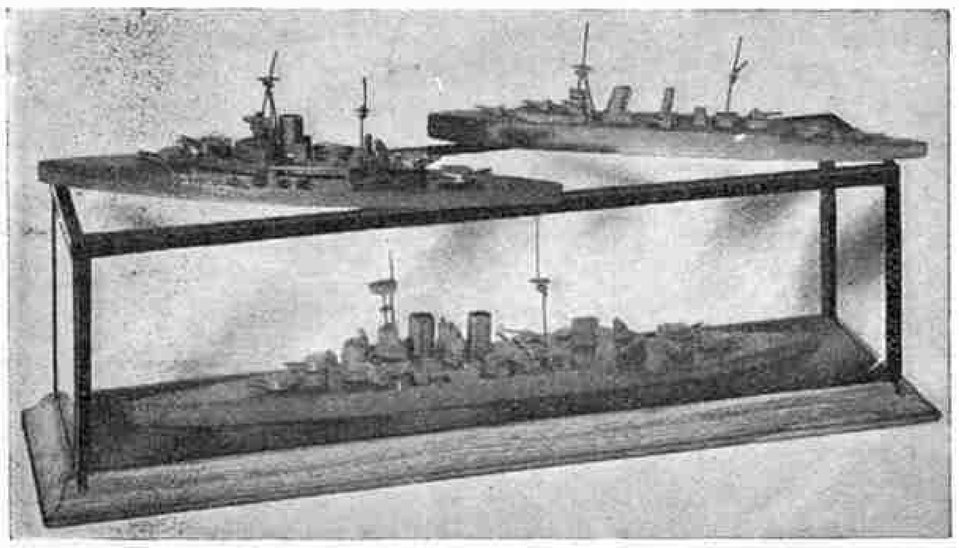

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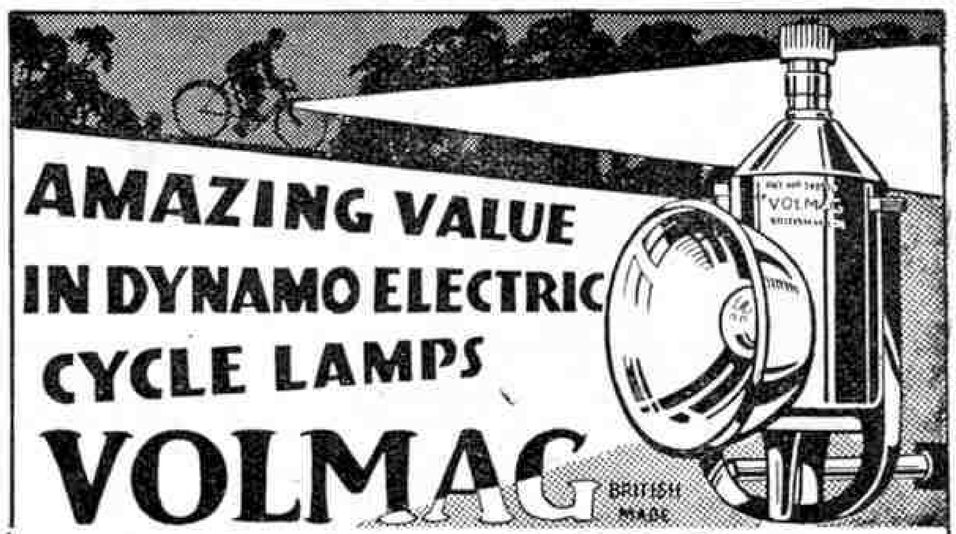

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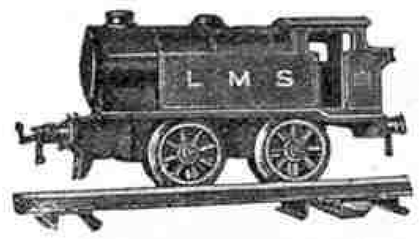

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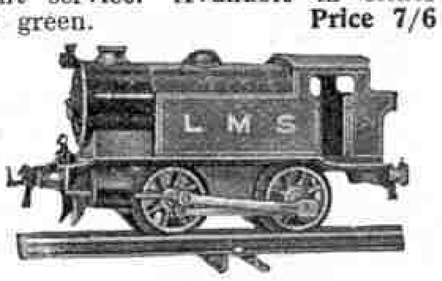

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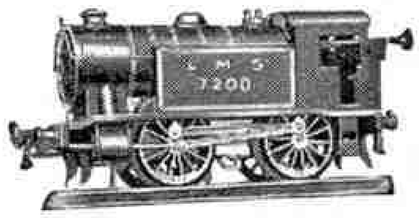

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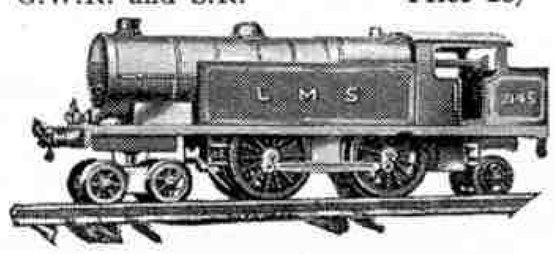

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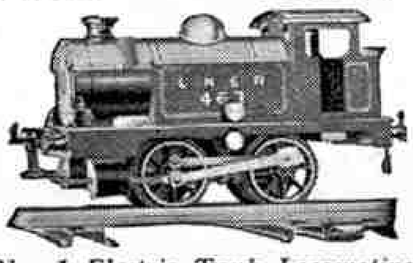

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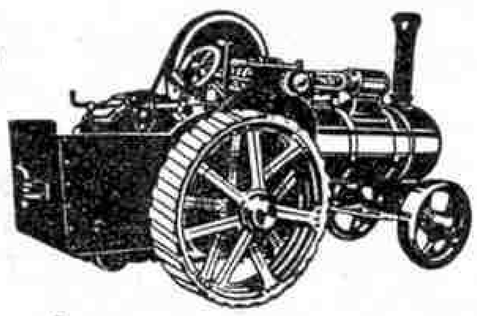

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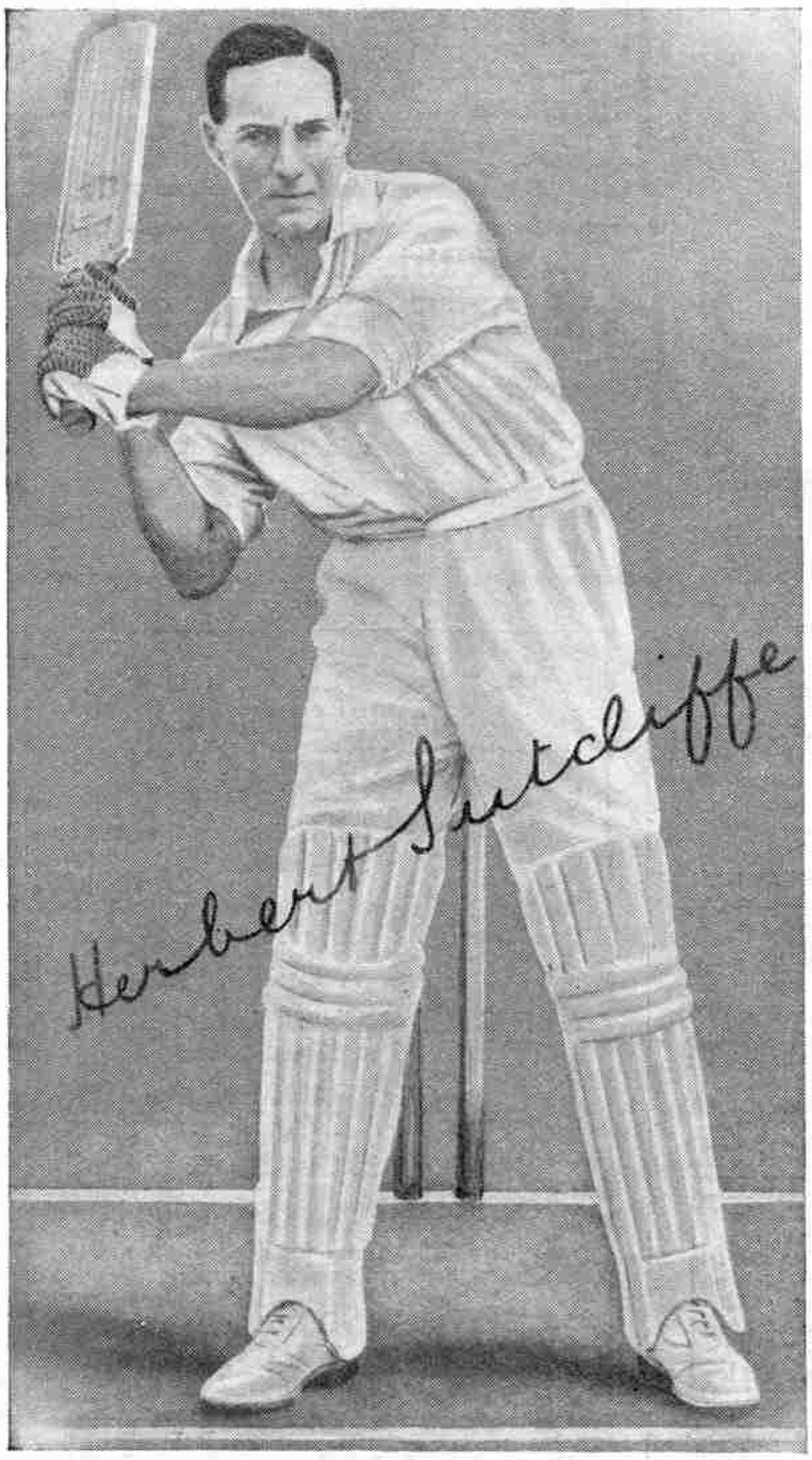

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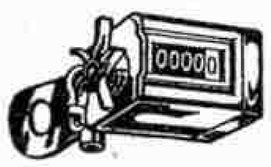

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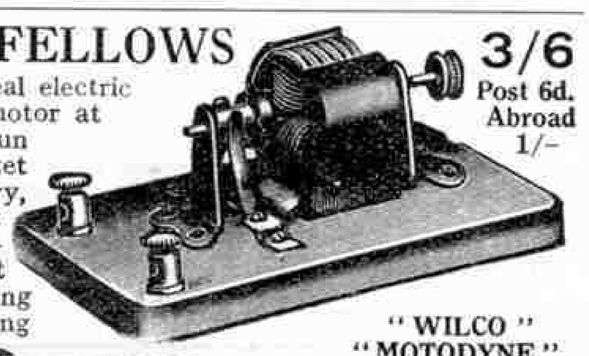

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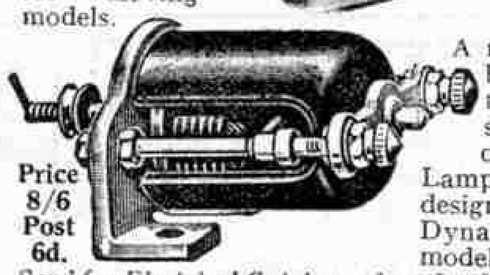

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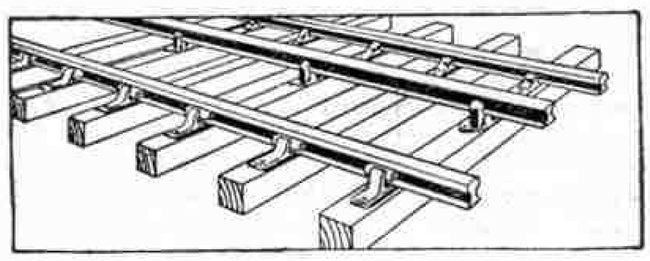

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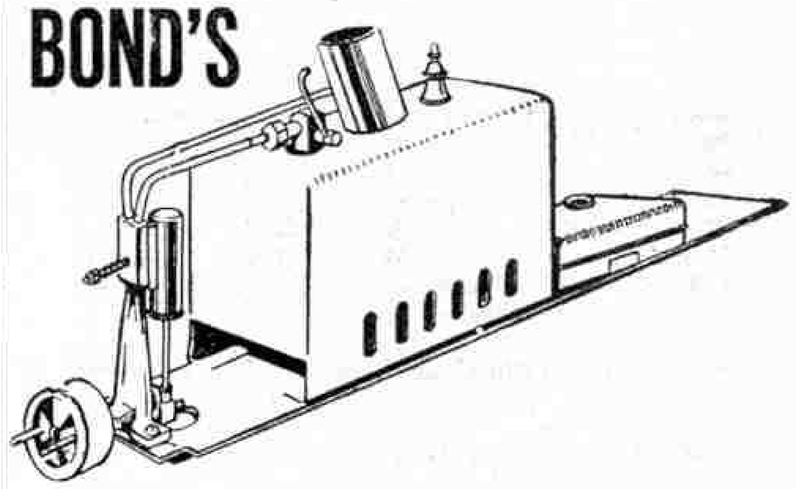

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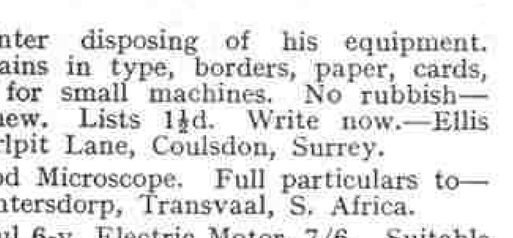

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EDITORIAL AND ADVERTISING OFFICE:—
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Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

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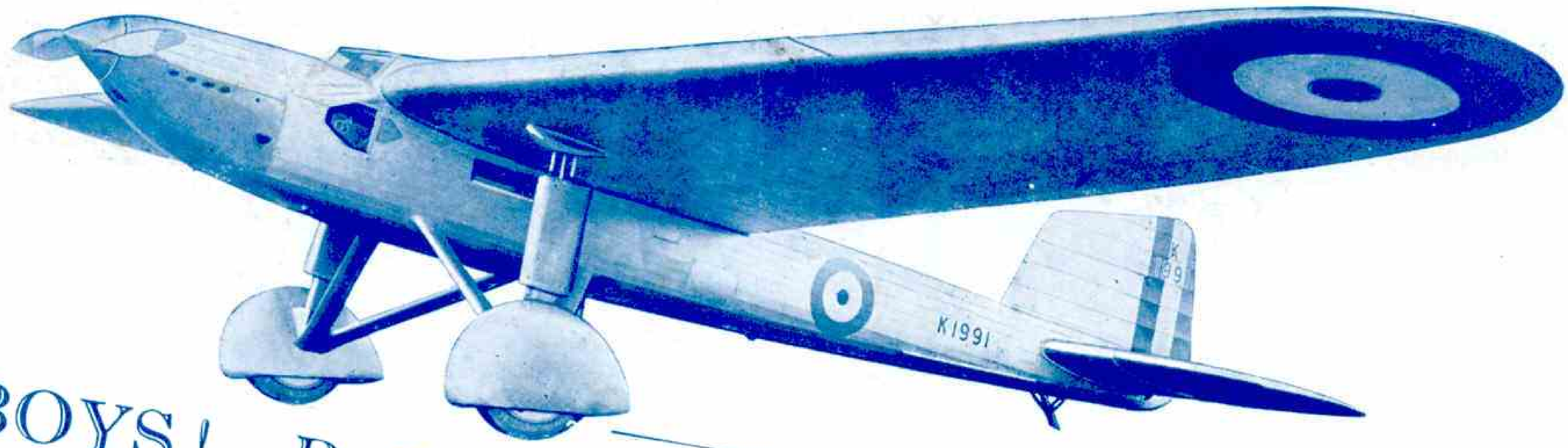

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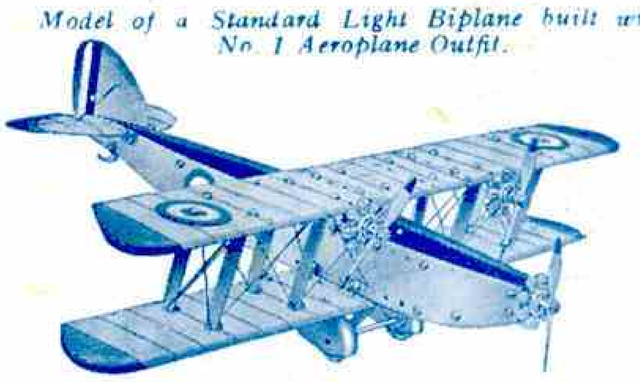

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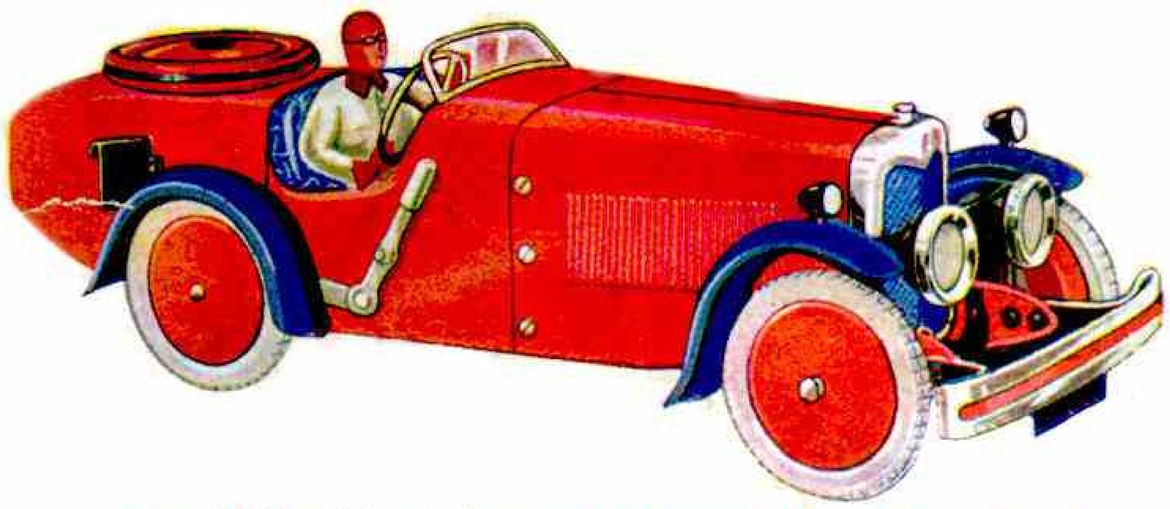
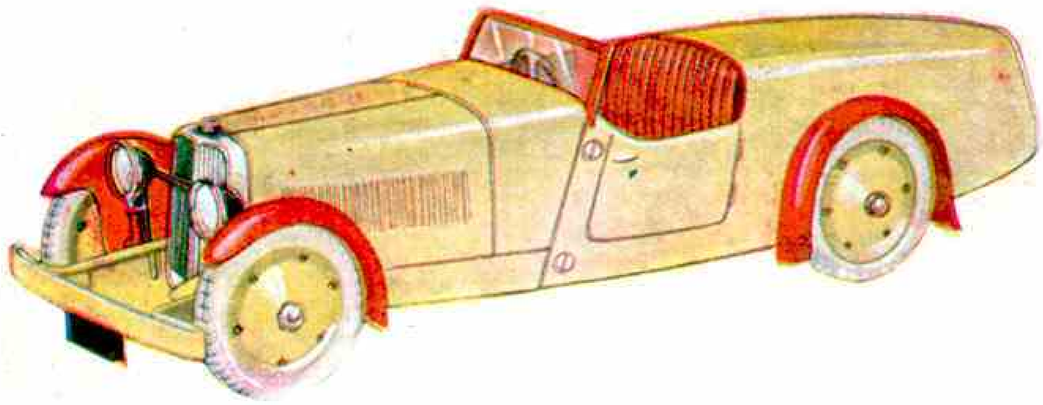
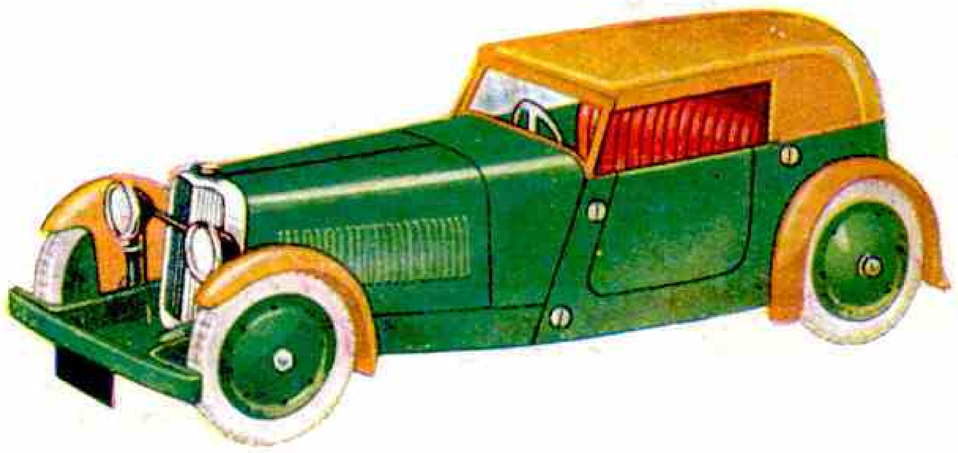


A model Road Racer built with Meccano No. 2 Motor Car Constructor Outfit. Note the hand brake operating on the rear wheel.

This realistic No. 2 Outfit Sports Tourer has a longer wheelbase than the model shown above, and another feature is the different type of wings.



An attractive model of a Road Racing Car built with the Meccano No. 1 Motor Car Constructor Outfit. It is a two-seater model with a streamlined tail.



This fine model represents a Four-Seater Sports Tourer, with the hood raised.

IMPORTANT. No. 1 Motor Car Outfit parts cannot be used in conjunction with those of the No. 2 Outfit.

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The Meccano Motor Car Garage provides accommodation for any Meccano model motor car or other car of suitable size. Price **7/-**

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